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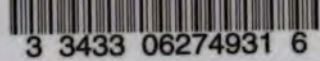
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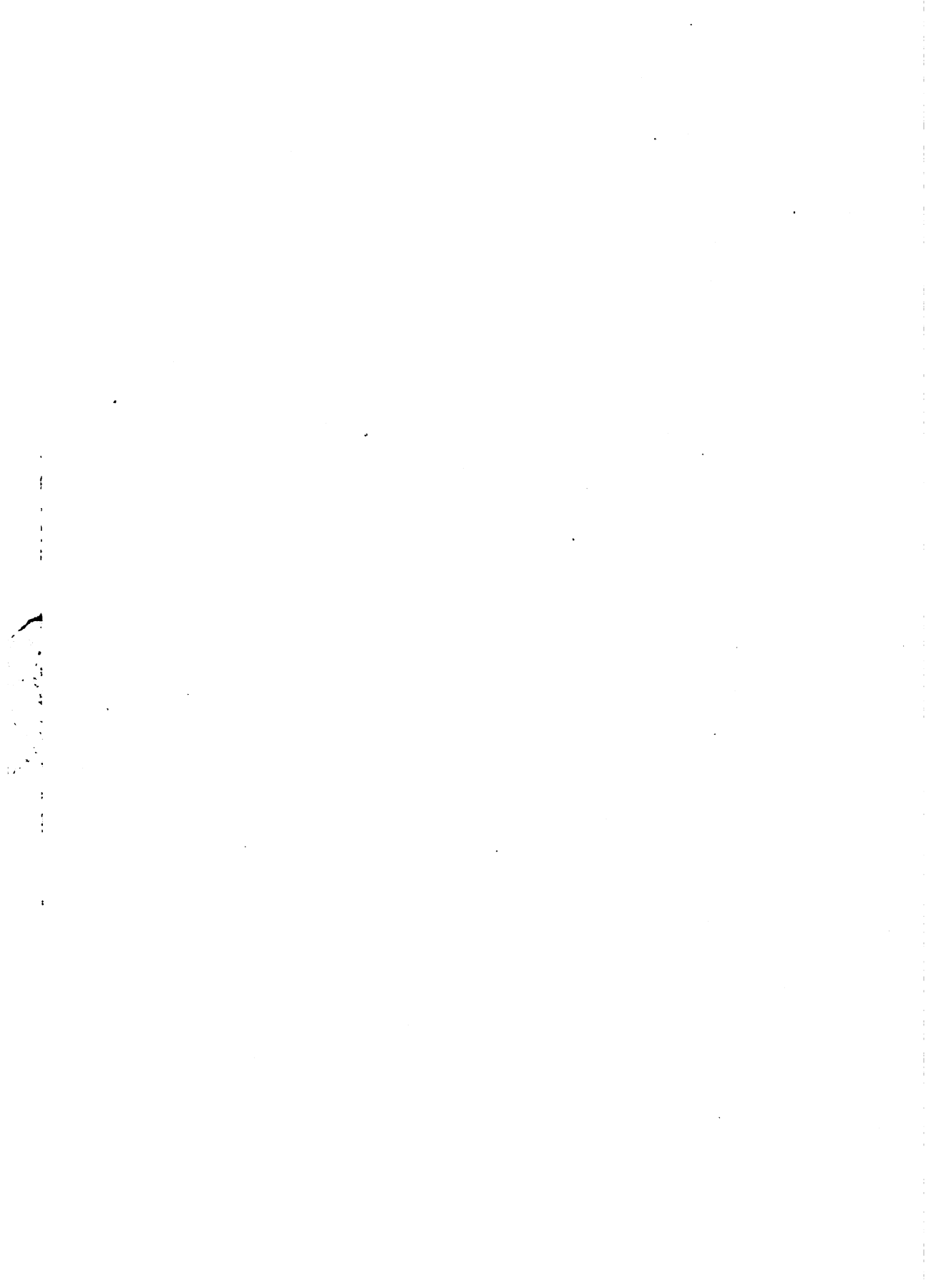
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WILLIAM CROOKES, F.R.S., &c.

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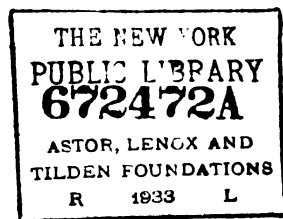
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THE CHEMICAL NEWS.

VOLUME XXXIV.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 867.—JULY 7, 1876.

THE CHEMICAL SOCIETY.

We referred last week to the fact that nine years ago there existed a similar state of affairs at the Chemical Society to that now existing. So precisely parallel are the two cases that the remarks we then made in this journal respecting the Charter and Bye-Laws of the Society are, we think, equally applicable to the present case. We therefore reproduce this article in the hope that a more careful consideration of the Charter and Bye-Laws will lead to the adoption of such measures as will render the recurrence of such disputes impossible.

"On his admission, each Fellow received the regulations of the Society, together with sundry other formal documents; but we venture to say that not many looked at them a second time, and few will now be able to lay hands on a copy of the Charter and Bye-laws, to which we now propose to direct attention. When everything is going on smoothly the laws and regulations of the Society are dormant.

"It now appears that for many years the Society has been acting contrary to the Charter in electing Fellows, honorary and foreign Members, and Associates, according to the existing Bye-laws.

"By the third paragraph of the Charter of Incorporation, granted to the Society in 1848, it is declared—

"That at all General Meetings and meetings of the Council the majority present and having a right to vote thereat respectively shall decide upon the matters propounded at such meetings."

"Again, the concluding paragraph of the Charter declares—

"That no resolution or bye-law shall, on any account or pretence whatsoever, be made by the said body politic and corporate in opposition to the general scope, true intent and meaning of this our Charter; and that if any such rule or bye-law shall be made, the same shall be absolutely null and void to all intents, effects, constructions, and purposes whatsoever."

"Now, it is very evident that the Bye-law, making the election of a candidate depend upon the votes of three-fourth of the Fellows present, is in direct contravention to the "true intent and meaning" of the first-quoted paragraph of the Charter; and therefore such Bye-law is, according to the terms of the second citation from the Charter, 'absolutely null and void to all intents, effects, constructions, and purposes whatsoever.'

"But it may be argued that the third paragraph of the Charter refers only to anniversary meetings or extraordinary meetings of the Society. An attentive examination will, however, show that by the term 'general'

meeting is intended that which is now commonly called an 'ordinary' meeting. The term 'ordinary meeting' strictly means *regular* or *customary* meeting: a *general* meeting means one public or common to the whole of the Fellows. Custom has sanctioned the omission of the word 'general' as qualifying the ordinary meetings, but it is still retained in Bye-law, which speaks of an *extraordinary* general meeting, which, logically and grammatically, can only mean a *general meeting* held *extra*, or in addition, to the *ordinary* bi-monthly meetings.

"The term 'general meeting' occurs several times in the Charter, but nowhere do we find the terms 'ordinary' and 'anniversary' meetings. When, however, we refer to the regulations of other learned societies, no longer can there be any doubt as to the meaning of the term 'general' meeting. In the Charter of the Royal Society no mention is made of meetings of the members, ordinary, extraordinary, or general. But in the Charter of the Zoological Society the term 'general' meeting is used in a sense applicable only to ordinary meetings; and in the Bye-laws the monthly meetings of the Society are invariably spoken of as 'general meetings,' or 'ordinary general meetings.' In the Charters of the Linnæan and Geological Societies likewise the term 'general meeting' is used to express the ordinary meetings of the members, and in the Bye-laws these are invariably termed 'general' meetings; the 9th section of the rules of the latter Society, in fact, state that 'the *general* meetings to be held by the Society shall be of three kinds:—1. *Annual*; 2. *Special*; 3. *Ordinary*.' It cannot, therefore, be doubted that the term 'general' meeting in the third paragraph of the Charter of the Chemical Society means the same as the term 'ordinary' meeting does in the Bye-laws.

"No one, we imagine, will dispute that the election of Fellows is a 'matter propounded' at a meeting upon which the 'majority present' are to decide. On the contrary, the question as to whether a candidate is to be admitted to the Fellowship of the Chemical Society is a very important matter propounded to those present who have a right to vote, and the question, above all others, which should be carried by a numerical majority.

"In strict logical interpretation, therefore, those candidates who were blackballed at the recent meetings of the Society were excluded from the Fellowship in error. A numerical majority of voters were in favour of their admission, and at the present time the blackballees are as strictly entitled to the letters F.C.S. as are any of the blackballers.

"We confess we see only one course to be pursued in respect to the Bye-laws which remit the decision on such important matters as the election or removal of Fellows

to a small minority, in opposition to the wishes of the great bulk of those present. Strictly speaking, these restrictive Bye-laws never had any legal existence, and they should at once be replaced by others in conformity with the Charter.

"One half of the problem now under discussion—that of preventing voting by ballot becoming an organ for the gratification of personal pique—has solved itself in a manner which leaves nothing to be desired. The first part of the question—How to guard against the admission of unfit persons into the Society—is one in which Council and Fellows are free to act, for the Charter specially provides that they 'may alter, vary, or revoke, and may make such new and other Bye-laws as they shall think most useful and expedient for the said body politic and corporate, so that the same be not repugnant to these presents.' Thus the way is clear to a satisfactory settlement of the recent unwarrantable proceedings and the permanent prevention of their recurrence, and to the establishment of safeguards against the degradation of the Fellowship of the Chemical Society."

NOTES ON VANADIUM COMPOUNDS.

By Dr. B. W. GERLAND.

I.—VANADIC SULPHATES.

1 (a). $\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 4\text{H}_2\text{O}$. Insoluble Modification.

VANADIC sulphate is readily obtained in solution by the action of dilute sulphuric acid upon vanadic pentoxide in the presence of reducing agents such as alcohol, sulphurous acid, hydrochloric acid, oxalic acid, &c. The blue solution thus produced is evaporated to the consistence of a syrup and mixed with strong sulphuric acid, whereby a voluminous precipitate is at once formed. After cooling, the excess of acid is removed, the residue treated with water, care being taken to avoid rise of temperature; it is then thrown on a filter and washed with cold water, or, what is preferable, with alcohol, and dried over sulphuric acid in vacuum. The salt is of a pale blue colour, and consists of microscopic needles, which are slowly soluble in cold, and rapidly in hot water. Exposed to the atmosphere, they absorb moisture and form a thick blue liquor. After being dried in this manner for two days, the compound was submitted to analysis. At 100° it lost water, and continued to do so for upwards of twenty-four hours.

The dried sample was dissolved in water, a little hydrochloric acid added, and the sulphuric acid precipitated as barium sulphate. This precipitate passes through the filter even after long-continued digestion in the water-bath, but this difficulty can be overcome by moistening the paper with ammonium chloride solution. The excess of barium was removed from the filtrate by sulphuric acid, and the clear solution finally titrated with permanganate for the estimation of the vanadic tetroxide.

Found.	Calculated for		
	$\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 4\text{H}_2\text{O}$	$\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 4\text{H}_2\text{O}$	$\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 4\text{H}_2\text{O}$
SO_3	51'48	52'10	50'14
Va_2O_4	35'21	36'17	34'81
H_2O (loss at 100°)			
in 24 hours) 3'58	13'31	11'73	15'05
H_2O (difference) 9'73			
	100'00	100'00	100'00

According to the analysis, the proportion Va_2O_4 and O_3 is—

$$\frac{35'21}{166'6} : \frac{51'48}{80} = 1 : 3'04$$

or nearly 1 mol. Va_2O_4 : 3 mol. SO_3 . The amount of water found corresponds as little with the formula $\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 3\text{H}_2\text{O}$ as with $\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 4\text{H}_2\text{O}$. Probably the last represents the original compound, and this parts,

with some of the water in a dry atmosphere of low temperature. I expect to clear up this point by a further investigation.

1 (b). $\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 15\text{H}_2\text{O}$. Soluble Modification.

This form of the sulphate is obtained by evaporating a solution of the crystals above described to the consistence of a syrup, and mixing the residue with strong alcohol, and in the same manner from the evaporated solution from which the crystals are separated. If the concentration is not carried far enough, the alcohol takes up a considerable quantity of the salt, and thus causes a loss; the separation of solid salt must, however, be avoided. The alcohol removes the excess of sulphuric acid, and but little of the vanadic sulphate. After repeated washings and thorough kneading, the alcohol dissolves no more of the salt, but still takes up traces of sulphuric acid. The sulphate now appears as a transparent blue mass, of wax-like consistence. It was left for some time over sulphuric acid without undergoing any change, and in this state submitted to analysis.

	Found.	Calculated for	
		$\text{Va}_2\text{O}_4 \cdot 3\text{SO}_3 \cdot 15\text{H}_2\text{O}$	
H_2O (loss at 100° in 24 hours)	21'74		
" " 3 "	0'39		
" 125° 12 "	3'06		
" " 3 "	0'17		
In the residue (difference)	14'98	40'34	39'91
Va_2O_4		24'78	24'62
SO_3		34'88	35'47
		100'00	100'00

By drying and long exposure to a temperature of 125° , this compound is not converted into the former one, the insoluble modification; the salt retains over 5 mols. of H_2O , and is still readily soluble in cold water and in dilute alcohol. The original compound, as it is separated by alcohol, rapidly absorbs moisture from the atmosphere.

The aqueous solutions of both modifications are identical in every respect. I have not succeeded in obtaining crystals from them, either by evaporation at low temperature or after the addition of sulphuric acid, nor by covering them with a layer of absolute alcohol.

The solution of the sulphate becomes dark green by the addition of ammonium vanadate, but remains clear in the cold; boiling produces dark green, almost black crusts, adhering firmly to the sides of the vessel, and reflecting the light strongly, whilst the liquor becomes lighter. Na_2HPO_4 produces with the solution of the vanadium salt a bulky greyish blue precipitate, which is readily soluble in an excess of the phosphate, and also in acetic acid; K_2CrO_4 forms a yellowish brown precipitate.

The mixed solutions of equal molecules of vanadium sulphate and potassium sulphate dry over sulphuric acid to a clear blue syrup, from which, after many days, a light blue powder separates. This is but slowly soluble in cold water, still less so in dilute alcohol, but hot water dissolves it readily. From this solution the new compound separates upon evaporation without any sign of crystalline structure; it is of very pale blue colour, and not hygroscopic. Two samples separately prepared and dried over sulphuric acid yielded the following results on analysis:—

	1.		2.	
Va_2O_4	21'43	1 mol.	25'08	1 mol.
SO_3	39'29	3'82	45'83	3'85
K_2O	21'03	1'73	23'18	1'63
H_2O (loss at 100°)	0'41			
H_2O (difference)	17'84	7'71	5'91	2'18
	100'00		100'00	

It is evident from these figures that both preparations were impure. They prove, however, that potassium has been substituted for hydrogen in the molecule of the

vanadium sulphate, and the mother-liquor from which the double salt separated, will contain acid potassium sulphate. The formula of the compound will probably be—
 $K_2(Va_2O_4)_3SO_4 \cdot xH_2O$.

The blue crystals, or the soluble modification, dried at 125°, placed in a thin test-tube and submerged in a bath of boiling vitriol or molten lead (330°), slowly lose water containing a little sulphuric acid, but the decomposition is so gradual that even after many hours the salts are still completely soluble. If, however, these salts, or the solutions from which they are prepared, are boiled with sulphuric acid for a short time they are completely converted into a heavy sandy powder of greyish green colour, the composition of which is represented by the formula $Va_2O_4 \cdot 2SO_3$, whereas the supernatant sulphuric acid is almost free from vanadium.

2 (a). $Va_2O_4 \cdot 2SO_3$. Insoluble Modification.

Prepared in the manner described, this consists of microscopic crystals, which are perfectly insoluble in cold water, even after a digestion of several months, and after long-continued boiling the water only shows a pale blue colour. This action of boiling water is very slightly increased by hydrochloric or sulphuric acid. Heated with a little water in a closed tube to 150° or 200°, complete solution takes place in a period varying from twelve to forty-eight hours, and sometimes more; but with more water a slight green sediment is formed under the same conditions. Dilute alkaline solutions decompose the compound with the formation of brown hydroxide, which is readily dissolved by acids.

The following analyses were made with samples prepared at different times. Nos. 1 and 2 were dried over sulphuric acid, No. 3 at 100°. In No. 1 the sulphate was dissolved by treatment with a dilute solution of soda, and subsequently with hydrochloric acid; the sulphuric acid was then separated with barium chloride, and the analysis carried out as described in 1 (a). In Nos. 2 and 3 the weighed sulphate was converted into the pentoxide by ignition, and the amount of tetroxide calculated from its weight.

	Found:—			The formula $Va_2O_4 \cdot 2SO_3$ requires—
	1.	2.	3.	
SO_3	49'52	—	—	48'99
Va_2O_4	50'80	50'18	51'22	51'01
Loss at 100°	0'18	—	—	—
	100'00			100'00

2 (b). $Va_2O_4 \cdot 2SO_3 \cdot x_2O$. Soluble Modification.

The insoluble sulphate, as already mentioned, is converted into a deep blue, thick, oily liquid, when heated with a small amount of water to 150° for some time. This mixes with water and alcohol, and may be boiled with either without suffering any change. The aqueous solution leaves a transparent, blue, gummy mass after evaporation over sulphuric acid, which in the course of a few weeks becomes quite hard, and is devoid of all crystalline appearance; but when moistened with alcohol and left under a loose cover it gradually assumes a crystalline texture throughout. Its solution in alcohol yields, on evaporation at low temperature, beautiful blue, well-defined crystals. I could only obtain the crystalline form from the gummy mass alluded to by the method described, and the precise manner of its formation remains as yet unexplained. I am endeavouring to prepare crystals for a crystallographical examination.

The analysis of blue crystals gave the following results:—

				The formula $Va_2O_4 \cdot 2SO_3 \cdot 10H_2O$ requires—
Va_2O_4	32'79			32'88
SO_3	—			31'58
H_2O expelled at 130° ..	26'37			35'54
				100'00

The solution of this sulphate gives, with ammonium vanadate, sodium phosphate and potassium chromate, the same reactions as the acid sulphate above described. It is not altered by sulphuretted hydrogen, but, after addition of sodium acetate and dilution with water, the gas precipitates a chocolate-coloured sulphide: it requires, however, days and weeks to complete the separation of the vanadium from the liquor.

As is already known, the vanadium sulphates are decomposed by heat into sulphurous and sulphuric acid and vanadic pentoxide, the latter of which fuses at a still higher temperature. Heated with acid potassium sulphate the vanadium sulphates fuse without decomposition; it is only at a bright red heat that they are converted into the pentoxide.

The behaviour of the first of these vanadium sulphates marks it out as an acid salt, whereas the second one bears the character of a neutral sulphate, and their symbolic representation seems best attained by the assumption of a quadrivalent radical, "Vanadyl," Va_2O_2 , which leads to the following formulæ:—

1 (a). $H_2(Va_2O_2)_3SO_4 \cdot 3H_2O$. Insoluble modification.—Hydric vanadylic sulphate.

1 (b). $H_2(Va_2O_2)_3SO_4 \cdot 14H_2O$. Soluble modification.—Hydric vanadylic sulphate.

$K_2(Va_2O_2)_3SO_4 \cdot xH_2O$. Potassic vanadylic sulphate.

2 (a). $(Va_2O_2)_2SO_4$. Insoluble modification.—Neutral vanadylic sulphate.

2 (b). $(Va_2O_2)_2SO_4 \cdot 10H_2O$. Soluble modification.—Crystallised vanadylic sulphate.

Berzelius described as acid sulphate of vanadium the compound $(Va_2O_2)_2SO_4 \cdot 4H_2O$. I have not succeeded in obtaining these crystals.

I am continuing the investigation of vanadium compounds, and hope for results which will elucidate their constitution.

II.—META-VANADIC ACID, $HVaO_3$.

I obtained this beautiful compound some years ago by treating with sulphurous acid the yellow crystals which formed by boiling the solution of the mineral copper vanadate in sulphurous acid (*Journ. f. Prakt. Chem.*, 1871, vol. iv., p. 40), after their partial oxidation by exposure to air (1).—(*Proc. Manchester Lit. and Phil. Soc.*, 1873, p. 50). Since then I have succeeded in preparing it by simpler methods. A cold saturated solution of copper sulphate is mixed with a strong solution of ammonium chloride in large excess. Ammonium vanadate in saturated solution is then added until a permanent precipitate appears, and the mixture slowly heated to 75°, when the formation of gold-like scales commences: this continues for some hours, until nearly all vanadium has separated as meta-vanadic acid, and only a trace is left in solution. The precipitate is collected on a filter, treated with dilute sulphuric and sulphurous acid (to remove small quantities of copper vanadate and red amorphous vanadic acid, which deteriorate the colour), washed with water, and dried (2.) The compound is now free from copper, but retains a small amount of ammonia in spite of repeated treatment with acids; the sample (2) when submitted to analysis contained sufficient ammonia to make it perceptible by smell on heating. This circumstance accounts for the loss by heat in the analysis being greater than the calculated amount of water. Prepared in this manner the meta-vanadic acid possesses the most brilliant colour and lustre. The bronze separates in much smaller scales of inferior colour and appearance, when dilute solutions, and particularly copper nitrate instead of the sulphate, are rapidly heated to the boiling-point. The meta-vanadic acid thus prepared more effectually resists reducing agents, as well as the solvent action of alkalis, so that boiling with ammonia or with sodium carbonate has no perceptible action. The purification is effected as above, with dilute sulphuric and sulphurous acid (3.) Meta-vanadic acid may also be obtained by adding a solution of ammo-

nium vanadate or acid sodium vanadate (the red salt) to the solution of a copper salt, separating the precipitate (which consists of copper ortho-vanadate, $\text{Cu}_2\text{Va}_2\text{O}_8$, with small excess of vanadic acid) and heating the deep yellowish brown solution, which has a strongly acid reaction to 75° . The colour becomes gradually fainter as the separation of the bronze proceeds. The filtrate from the copper vanadate contains, even if vanadate has been used in excess, a small amount of copper, which separates with the scales, but is easily extracted with dilute acids (4).

Copper salts can be replaced by zinc salts, and probably by salts of any heavy metal which forms a sparingly soluble ortho-vanadate, and is not precipitated by ammonia in the presence of ammonium salts. Ortho-vanadates of copper and zinc are partially converted by long-continued boiling with ammonium chloride into meta-vanadic acid.

The materials for the analyses were weighed after drying in the water-bath, then heated to redness; the loss calculated as water, and the residue as vanadic pentoxide. The residue of No. 1, which was prepared from impure materials, was fluxed with sodium carbonate, dissolved in water, and a small quantity of insoluble matter, consisting of lime and ferric oxide separated; the filtrate was acidulated with acetic acid, and lead acetate added; the precipitated lead vanadate was washed with water, and decomposed with sulphuric acid and alcohol: upon evaporating the solution of vanadic acid and igniting the residue, the vanadium pentoxide was left in a pure state.

	Found.				Calculated for HVaO_4 .
	1.	2.	3.	4.	
H_2O (loss by ignition)	8.73	9.12	9.22	9.34	8.97
Va_2O_5	91.06	90.88	90.78	90.66	91.03
Impurities ($\text{CaO}, \text{Fe}_2\text{O}_3$)	0.21	—	—	—	—
	100.00	100.00	100.00	100.00	100.00

Meta-vanadic acid is a highly hygroscopic substance. It suffers no change at 150° ; at higher temperatures it loses water and leaves vanadic pentoxide, which fuses at a still higher temperature.

I am still engaged with the study of the formation of this remarkable form of vanadic acid, which resists chemical reagents to a surprising extent; meanwhile I communicate some experiences that may be of interest.

The filtrate from the copper vanadate (4) yields, on heating, less of the meta-acid the longer it has been kept, so that after eight or ten days it remains clear on boiling. This change is not indicated by any visible alteration.

The original liquor evaporated in a thin layer at low temperature leaves a crystalline residue: this forms a clear solution with cold water, which, heated to 75° , deposits meta-vanadic acid in scales.

The same liquor parted, on the dialyser, with all the salts within five days, whilst but little of the vanadic acid penetrated the parchment paper. The vanadic acid was left in a new soluble modification; its solution yielded no scales on boiling, but remained clear, and deposited red amorphous vanadic acid after considerable evaporation.

The meta-vanadic acid possesses properties which recommend it as a substitute for gold-bronze. With care it can easily be obtained of beautiful colour and lustre, almost equal to gold, and as a very fine powder, mixing readily with gum or oil. It is in no way affected by the atmosphere or by moisture.

Macclesfield, May, 1876.

FORMATION OF OZONE BY THE CONTACT OF PLANTS WITH PEROXIDE OF HYDROGEN.

By S. COHNÉ.

If a fresh stem of a plant is put into a test-tube filled with a weak solution of peroxide of hydrogen, the latter decomposes, and almost immediately the oxygen bubbles are seen rising to the surface, and a portion of the oxygen

will be found to be ozone, which may be proved by the known test of a strip of paper saturated with iodide of potassium.

When the moistened paper is put on the top of the tube without touching the water in the tube, the paper turns brown.

If a flower with its stem and leaves is put into the tube, the decomposition of the peroxide will be caused by the entire plant, but in the same way as the absorption of the plants, when in a growing state, is most active at the sponges or hairs which terminate the roots, so decomposition of the HO_2 mostly takes place at the end of the stem where it is cut through, also at the leaves.

The presence of the ozone may also be proved by its density. If the tube is shaken a little, the active or ozonised oxygen rises more freely from the bottom of the tube, because the ozone is more dense than ordinary oxygen. The decomposition goes on gradually, and if a bunch of flowers, instead of being put into a glass filled with water only, is put into a glass filled with a weak solution of HO_2 , the room may be filled with ozone in a more simple and easy manner than by any other known process.

If a strong solution of HO_2 be used, the active oxygen evolves itself tumultuously, and if an electrophore is placed near it, a slight deflection takes place, proving that there is chemical reaction going on, but the flowers then very soon fade.

ON THE ACTION OF CERTAIN KINDS OF FILTERS ON ORGANIC SUBSTANCES.

PART II.

By J. ALFRED WANKLYN.

In continuing my investigation into the action of the silicated carbon filter, I have proceeded to experiment on solutions containing a by no means infinitesimal quantity of organic substance, and, as will be apparent from the following details, have obtained a very striking result.

In these experiments I employed a rather larger filter than before, viz., a filter containing a cake of silicated carbon 6 inches in thickness, and the filter was quite new.

Experiment I.—Into a quantity of boiled London water (which yielded 0.00 milligramme of free ammonia and 0.04 milligramme of albuminoid ammonia per litre) I placed a weighed quantity of acid sulphate of quinine. In this manner a large volume of dilute solution of acid sulphate of quinine of such a strength that one litre contained 14.2 milligrammes of the acid sulphate was prepared. Before making the experiment with the filter I subjected some of this dilute solution of quinine to the ammonia process, and obtained from 1 litre—

Free ammonia	.. .. .	trace
Albuminoid ammonia	.. .. .	0.48 m.grm.

The solution was then poured on the filter, care having been taken beforehand to empty out all the water which was in the filter.

The first litre of filtrate was thrown away, inasmuch as I considered that the first litre would consist of water displaced by the solution of quinine. Successive half-litres of filtrate, as they came through the filter, were analysed with the following results:—

		Milligrams. per Litre.	
		Free Ammonia.	Albuminoid Ammonia.
No. 1	.. .. .	0.24	0.04
No. 2	.. .. .	0.14	0.04
No. 3	.. .. .	0.15	0.04
No. 4	.. .. .	0.14	0.02

The circumstance of the low yield of albuminoid ammonia not being confined to the first portions of filtrate, is a demonstration that I had eliminated the influence of dilution by water previously occupying the pores of the

filter, and the result may be accepted with confidence that a solution of quinine, which yielded 0.48 m.grm. of albuminoid ammonia per litre, was so purified by a single filtration through 6 inches of "silicated carbon" that after filtration it yielded only 0.04 or 0.02 m.grm. of albuminoid ammonia per litre.

Encouraged by this result I prepared a much stronger solution of quinine, viz., a solution containing 118 m.grms. of acid sulphate of quinine per litre. The acid sulphate of quinine which I employed was in large crystals, and had been previously investigated and found to contain 21.1 per cent of water of crystallisation. As the reader will observe the above-mentioned solution contained 8.26 grs. of the salt to the gallon of water, and such a solution is quite bitter to the taste.

Experiment II.—The above described solution of quinine (118 m.grms. of acid sulphate of quinine in a litre of water) was passed through the filter, and after rejecting the first litre of filtrate, examinations of the further filtrate were commenced. The filtrate yielded—

Milligrams. per Litre.	
Free Ammonia.	Albuminoid Ammonia.
0.20	0.02

This result was further confirmed by evaporating a quantity of the filtrate down to dryness and weighing and igniting the residue. As will readily be understood, a solution containing as much as 8½ grs. of sulphate of quinine per gallon is strong enough to be dealt with by simple means, and accordingly I experimented in that manner with the solution before and after filtration, and got perfectly satisfactory results. Finally, I tasted the filtrate and found that all bitterness had gone away.

Thus I have arrived at the startling result that by a simple filtration through 6 inches of silicated carbon a solution of quinine, containing 8½ grs. of the acid sulphate per gallon of water, is totally deprived of quinine. I am extending the investigation to non-nitrogenous organic substances, and have operated upon a 10 grain to the gallon solution of cane sugar. Action there seems to be; but, so far as I am able to judge at present, it is neither so rapid nor so complete as in the instance of quinine and nitrogenous substances generally.

REPORT ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.
(Continued from p. 253.)

Chlorine, Bromine, Iodine, and Fluorine.
By Dr. E. MYLIUS, of Ludwigshafen.

WHERE two muffle furnaces are in use with a total weekly yield of 8000 kilos. of salt-cake on the system of condensation just mentioned, 15 metres in height and 2.3 metres in the square (interior measurement) suffice for the production of a strong acid. At any rate the condensation is so perfect that in the second, or "washing tower," which may measure something less in the clear, the acid obtained does not exceed the strength of 1° B., which may be let pass away in each channel, if it is not preferred to let it pass down in the second or condensation tower. The acid from the first tower may be further strengthened in the first trough—in which most of the accompanying sulphuric acid is condensed—with a view to its utilisation in the manufacture of chloride of lime.

Particular attention must be paid to the towers when fitted up. They are filled either with bricks or coke, the latter material being preferable on account of its larger

surface, greater power of resisting hydrochloric acid, and its less weight. Sometimes a combination of both materials is made, the bricks being placed below and the coke above. In order to distribute the water equally among the contents of the tower we employ either a rocking trough or Segner's water-wheel. The coke must be filled in neither too compact nor too loosely; the former error impeding the movement of the gases, and the latter leading to the subsequent settlement of particular portions. In both these cases the gas selects the more open passages, and a large part of the tower may be thrown out of action. The towers may also deviate from the perpendicular, when the water runs down one side alone, leaving the other nearly dry, and as these parts allow the freest passage to the gases the actual absorption becomes very small.

A very convenient arrangement for condensation is the combination of coke towers and Woolff's bottles, introduced at Stolberg and elsewhere. The gases escaping from the salt-cake pans and muffle furnaces, considerably cooled in passing through a long series of earthenware pipes, are led into a long row of Woolff's, tubulated on both sides at a fourth of their height reckoning from the bottom and connected by caoutchouc tubes well secured with cement; thus the liquid in all stands at the same level. From these the gases enter the coke towers, whence the condensed acid flows back into the Woolff's bottles to be there strengthened by the muriatic acid gas continually streaming over it, and thus reaches the required strength (Hasenclever).

In England the condensation of the hydrochloric acid is carried so far that whilst in the first year of the operation of the Alkali Act, 1.28 per cent escaped, in the second the loss was reduced to 0.88 per cent, in the third to 0.73, and in many works as far as can be ascertained the condensation is perfect.

(To be continued)

NOTICES OF BOOKS.

Discursive Chemical Notes in Rhyme. By the author of the "Chemical Review," A. B. Part I. The Non-Metallics. London: Van Voorst.

THE example of Sir Humphry Davy notwithstanding, chemists are not generally credited with poetical tendencies. The philosopher of Penzance, too, when courting the Muses found his subjects outside the laboratory; but the author of the little work before us, with greater daring, gives us in verse the chemistry of the non-metallic elements, and despite the refractory and unpromising nature of the subject the result is very far from a failure. Whether, if he continues his task, he may some day succeed in weaving the neo-chemical nomenclature of organic compounds into easily flowing verse the future can alone decide. But this poem is not merely a "philosophy in rhyme" dealing with the hard, dry facts of the science, it is also a satire. Chemistry has its theories, perhaps its dreams, insisted upon the more strongly in the exact ratio of their absence of solid foundation. Chemists, too, like other men—and more than most men—have their rivalries, jealousies, feuds, and cliques. Even the prospect of finding their duties and the accompanying emoluments gradually absorbed by the engineers is not enough to compel them into unity. There are those who say in their actions, if not *totidem verbis*, "perish the profession, if we may not rule it."

There is consequently good scope for satire, even of a sterner and more uncompromising type than what is introduced in these pages. Our author, even where he points out what is unsatisfactory, is good natured and says of himself, not untruly:—

"To hurt one's feelings I could no more write
Than walk to the Land's End like Walter White."

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

As a specimen of his satirical vein we quote the following:—

"But as I always wish to be particular,
And act in concert with the modern school,
I must not be atomic, but molecular,
Or Williamson might take me for a fool;
So in this wise our formula we spell
Twice KCl , and ditto KCl .
Plus six of oxygen or $3O_2$
(I think I'm right, but yet feel rather hazy;
For after thirty years or so the new
Strange formulae will tend to drive one crazy,
And make him half inclined to write a letter
To some great gun and say 'The old are better').
I took up Frankland's book the other night
('Tis very clever, anyone may see),
And, musing, wondered could a chemist write
So quaint a work and out of Bedlam be:
And all to please his college-boys (the Turks!)
With graphic formulae like fireworks—
With h's small and very fat round O's,
Conjointly placed near apoplectic Q's
In curious brackets, which, we may suppose,
Are only there to irritate and tease.
I gave it up when reading this queer type,
And, growing sorrowful, smoked half a pipe."

Of "hydroxyl" the author exclaims somewhat profanely, but aptly—

"Yet do not, if you love me, blame the muse,
But rather this damn'd radicle abuse!

After paying a graceful tribute to the memory of Faraday, Graham, and Liebig, the poet bids us—

"Then cheer up, brothers; there are many yet,
Thank God! amongst us who can hold their own.
Great Time hath wrought its change and brought regret
For those who once within our circle shone:
Mourn as we must the many who are dead,
Gilbert is with us, though his Pig is dead."

Perhaps it is as well, both for Dr. Gilbert and the Society, for in these days it is hard to name any possible experiment upon or with animals which may not be construed as vivisection. Therefore let this "Fellow" rest in peace.

To make further quotations would hardly be just to our author, but we think the specimens we have given may make our readers inclined to enquire further. We believe that, like ourselves, they will conclude that the pen of this anonymous poet will be of service both to the science and to the profession.

The Miners' Cursfew and other Matters, Social and Political.
By LEWIS THOMPSON, M.R.C.S. Newcastle-upon-Tyne: Daily Journal Office.

This pamphlet contains a description of an arrangement which is to give warning, by ringing two or three bells "as soon as ever the air that surrounds it becomes dangerous to human life from an accumulation either of fire-damp or choke-damp." The principle is that of the well-known electric bell, the circuit being closed and the bells caused to ring by a derangement in the equilibrium of a balance. Two oiled silk bags are taken, of a spherical form, and equal as nearly as possible in size and weight. "One of these bags contains no air, but is compressed into the shape of a plate, so as to present on each side a surface equal to the area of a great circle of the other bag, which, however, is filled only to the extent of four-fifths with atmospheric air, and then securely tied. These bags are to be hung at the two arms of a balance, and carefully counterpoised." The air in the full bag, of course, will expand and contract with the surrounding air, and hence will not be affected by barometric or thermometric changes. But if the air becomes mixed with a lighter gas, such as light carburetted hydrogen, the filled bag will descend, the circuit will be closed by means of a bent wire, and the bells will begin to sound. If, on the other hand, the air is rendered heavier by an admixture with carbonic acid, the other arm of the balance descends, and the bells are equally set in action. The bags are of oiled silk, like that used for balloons, and each of them is to contain about 250 cubic inches of air.

This idea, it must be admitted, is highly ingenious. As

the author remarks, the balance with its bags must be placed close to the spot where the men are engaged. It must, at the same time, be secured from currents of air, from injury by falling rubbish, and from being foolishly played with.

A succeeding portion of this pamphlet treats of the manufacture of illuminating gas without the use of coal. Since his former pamphlet upon coal-gas, the author has received fourteen letters from persons who describe themselves as "interested in gas-making," and who express a hope that he will not "lend himself to gas agitation." His proposal is to heat charcoal in a slow current of atmospheric air, and pass it through a receiver filled with benzoline of sp. gr. 0.704, at the temperature of 50° F. The process, as is evident, is free from nuisance, and can be easily managed in a private house. As regards the cost, the author cannot speak definitely, because he has found the prices both of charcoal and benzoline vary to the extent of 300 per cent.

To get rid of gas companies, who in places where the ratepayers have not been wise enough to take such matters into their own hands generally have contrived to obtain a dangerous amount of power, and who too often use it in a somewhat high-handed manner, would be a boon of no small magnitude. But at present the abolition of the gas manufacture, with all its admitted drawbacks, would be most unpleasantly felt by those branches of industrial chemistry which utilise its by-products.

The remaining parts of this pamphlet, though by no means devoid of value, cannot be consistently noticed in the CHEMICAL NEWS.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—The Chemical Society is undoubtedly passing through a crisis, the satisfactory termination of which will not be facilitated by the use of such expressions as "indiscriminate or reckless blackballing," "blackballing clique," "meaningless and ill-natured blackballing," &c. I am one of those who believe that blackballing has been carried somewhat too far, but I also believe that it has been done from pure motives, however mistaken they may be; and if this is so, surely it is better to meet the party by argument, and not by abuse, which will only recoil on those making use of it.

As far as I can learn, the present agitation is caused mainly by the conviction, shared by many, that the Fellowship of the Chemical Society is, to the majority of English chemists, the only distinction within reach which might stamp them as chemists, and that such stamp should be made an honour worth having. Entrance into the Society has, however, it is argued, been made so easy of late that its Fellowship has ceased to be any real distinction. It is therefore proposed to restrict entrance to real chemists only, and thus restore the prestige formerly connected with the letters F.C.S. On the other extreme side, it is said that the Chemical Society has been established for the general promotion of chemical science, and not for the purpose of stamping its Fellows as chemists; that for the promotion of such object much money is wanted, and that all who are willing to pay assist the Society in doing its legitimate work, and are therefore entitled to be admitted as Fellows.

Now it appears to me that much may be said on both sides of the question, and that at any rate it cannot be settled by the use of harsh terms. Would it not, then, be best for those who desire alteration to hold a public meeting, thoroughly discuss their side of the question, and, if possible, pass resolutions embodying the changes proposed? Such resolutions should then be laid before the

Council, which, I doubt not, would take them into careful consideration, and, if thought desirable, would further take the opinion of the Society at large on the subject.

The party, whichever it might be, which would then find itself in the minority would, it is to be hoped, have sufficient good sense and good feeling to conform to the clearly expressed wish of the majority.—I am, &c.,

A. DUPRÉ.

Laboratory, Westminster Hospital,
London, S.W., June 29, 1876.

To the Editor of the Chemical News.

SIR,—You have very justly reminded your readers that systematic blackballing is not a new thing in the Chemical Society, and that in 1867 there was an outbreak of blackballing which compelled the Council of the Society to take action. In point of fact systematic blackballing is the form in which the dissatisfaction which generally prevails in the Chemical Society makes itself manifest from time to time.

The structure of the Chemical Society, like that of other so-called learned societies, is very peculiar. Nominally the Chemical Society is a republic of the most democratic character, inasmuch as the Council and officers hold office solely by virtue of a majority of votes given by the Fellows, and each Fellow has only one vote.

Really and in practice, however, the elective power of the Society remains permanently in abeyance; and the Council of one year re-elects itself and its nominees to form the Council of the next year. It is notorious how thinly the anniversary meetings are attended, and that not one-tenth (and probably not one-twentieth) of the 600 or 700 Fellows of the Society take any part in the election of the Council of the Society. Inevitably this state of things develops "officialism," and leads to all those evils the existence of which is announced by the systematic blackballing which is so prevalent in the Chemical Society.

The best remedy would be to induce the Society as a whole to vote for its Council. Failing that, it would be wise to draw lots for the Council, which might afterwards choose the President and officers. It does seem to me that a sham annual election must be a source of danger to any Society.—I am, &c.,

J. ALFRED WANKLYN.

To the Editor of the Chemical News.

SIR,—“History is said to repeat itself.” Of all our oft-repeated phrases this one is perhaps the most illusory. With equal truth the same might be said of waves or volcanic outbursts. But just as the ripple may be the precursor of the tempest, the underground rumbling may betoken a violent eruption.

In the Chemical Society in 1867 signs of dissatisfaction were manifest; we are told that a “somewhat widespread dissatisfaction” now exists, and relating too to the same cause—that is, to the election of Fellows. The '67 agitation was productive of only a small amount of good, but it by no means follows that the '76 or '77 movement will be of so little import to the chemist. Change of time has brought change of aspirations. Intestine wars among the Fellows are a natural consequence of their heterogeneous character. The idle never yet agreed well with the industrious. The chemist and non-chemist cannot be expected to blend and harmonise one with the other. This is well illustrated by the so-called “organisation” movement, one of the objects of which is to sift these incompatible elements.

The only scheme before us relating to the subject is the one published in the CHEMICAL NEWS (vol. xxxiii., page 240) by the “clients” of Mr. Pettengill, which I believe to be the most suicidal and impracticable possible to have been devised.

The only part of the scheme which immediately concerns the present generation of chemists, and on which I

shall offer a few remarks, is a clause relating to “persons now employed as chemists.” I would urge every chemist to read this carefully, and then ask himself whether he be eligible for the membership of the proposed Institute. Many of my friends, veterans of upwards of ten years, would certainly be excluded, and I doubt whether it would be possible for the gentlemen who sat on either side of Prof. Abel at the organisation meeting at Burlington House to squeeze in except by a side door, which, to say the least, renders the thing ridiculous.

In a former communication I pointed out what I considered to be the great desideratum, namely, *unity amongst chemists*, which I thought might be effected by the time-honoured Chemical Society. Dr. Wright's elaborate summing up has so far discountenanced this idea that I think the time has come for chemists most sincerely to consider the advisability of bringing this about by independent action. The success of any movement to found a *representative* chemical corporation must ultimately depend upon its receiving the support of the present generation of chemists. To do this effectively all chemists, scientific or technical, must be invited to join and assist. It is premature to lay down any unauthorised restrictions as to age or other qualifications, and it would be invidious—nay, impertinent—for Chemist A to sit in judgment on the qualifications of his brother B.

Again, any scheme, to be successful, must be comprehensive, and sufficient to *attract* all men now engaged as chemists, or it will most assuredly be annihilated by the successful opposition of those whom it would vilify, ostracise, and threaten with ruin.—I am, &c.,

ALFRED TRIBE.

Dulwich College, July 4, 1876.

To the Editor of the Chemical News.

SIR,—Now that the subject of organisation amongst chemists is being so largely discussed in the columns of the CHEMICAL NEWS, I will beg permission to make known to your readers some of the details of a case in which the initials F.C.S. appear in an advertising pamphlet in a manner which cannot but be considered as most derogatory to the science.

The particular case to which I am about to direct attention has been already brought under the notice of the Chemical Society on the occasion of the last anniversary meeting; but, as the pamphlet was not at the time at hand, the speaker (Mr. R. J. Friswell) could give no details. As the pamphlet is accessible to all, there is no occasion to suppress names. To quote from the wrapper—“J. N. Hearder's Guide to Sea Fishing.....and Descriptive Catalogue of his Prize River and Sea Fishing Tackle, Cricket, Archery, Croquet, Umbrellas, Parasols, &c.” The above is repeated, with some few additions, on the title-page, which concludes with “Lecturer on Chemistry and Experimental Physics, D.Sc., Ph.D., F.C.S.” On page 52 we have a catalogue of “philosophical apparatus” (immediately following the list of umbrellas and parasols), and after this the public is informed that “J. N. Hearder, D.Sc., Ph.D., F.C.S., may be consulted on all subjects relating to the practical application of science to the arts and manufactures. He is also prepared to deliver lectures on any branch of science to scientific institutions.” On the opposite page, by way of antithesis, we read—“Smiths' work in general; gas-fitting in all its branches; bell-hanging, &c.” The author here describes himself also as a “warming and ventilating engineer.”

Even if the demands upon your space permitted, further comment upon these extracts would be unnecessary.

They plead for themselves, “like angels, trumpet-tongued,” in favour of reorganisation.—I am, &c.,

R. MELDOLA.

Belle Vue House, Twickenham, July 3, 1876.

—[The discussion on “The Chemical Society” and the “Organisation” movement, having occupied a great deal of our space during the last few weeks to the exclusion of

other important matter, we are compelled to decline to insert any more letters on the subject for the present, unless, indeed, our correspondents have any new information to give, and then it will be necessary for the letters to bear the writers' names.—*Ed. C. N.*]

ANALYSIS OF PEROXIDE OF MANGANESE.

To the Editor of the Chemical News.

SIR,—The analysis of a sample of peroxide of manganese, given by Dr. Phipson in the *CHEMICAL NEWS* (vol. xxxiii., p. 243) is of interest from the large number of elements found. There is one point on which I (and possibly other of your readers) should like further information. The author writes:—"The quantity of MnO_2 being calculated in the usual manner, the rest of the manganese was considered as Mn_2O_3 , though there are doubtless small quantities as MnO ." As I frequently require to make complete analyses of manganese ores, I am curious to know how Dr. Phipson distinguished the MnO_2 from the Mn_2O_3 . Both these oxides exercise an oxidising action, though of course the available oxygen of the latter is only half that of the former. As all the methods of determining MnO_2 (as distinguished from MnO) with which I am acquainted are based, directly or indirectly, on its oxidising power, how did Dr. Phipson distinguish it from the remaining oxide of manganese if the latter was Mn_2O_3 ? Is it not evident that the oxide which was not recognised by any process of "chlorimetry" must have been MnO ? Is it not impossible to distinguish analytically between Mn_2O_3 and $MnO + MnO_2$? If so, Dr. Phipson has counted his oxygen twice over.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, July 3, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 22, May 29, 1876.

Atomic Constitution of Bodies.—M. de St.-Venant.—The author concludes that we cannot, without placing ourselves in contradiction with the totality of celestial and terrestrial phenomena regard atoms as corpuscles formed of hard and continuous matter, but that there is nothing contradictory in considering them as material points endowed with all the properties, save extension, which we observe in visible and tangible bodies.

New Remarks on the Real Existence of a Matter formed of Isolated Atoms comparable to Materials Points.—M. Berthelot.—The conception of a single and fundamental kind of matter, of which the multiple states of aggregation constitute the elementary bodies that we know, with their specific properties—a conception to which eminent minds give their adhesion—seems to imply that the atomic masses of our elements are far removed from the condition of true atoms.

Salts Formed by the Peroxide of Manganese.—M. E. Fremy.—The author shows that the peroxide of manganese under different circumstances may behave either as indifferent, acid or basic, and forms salts in which he considers that it plays the part of a base.

Examination of the Possible Mechanical Action of Light: Study of the Radioscope of Mr. Crookes.—M. A. Ledieu.—The fact that the luminous rays produce generally little heat would show precisely that the *vis viva* which the luminiferous vibrations of the ether give off must tend to convert itself almost entirely into motion.

Radiometer of Mr. Crookes.—M. W. de Fonville.—The experiments executed by M. Darlu de Roissy and myself in the photometric laboratory of the gas works at Vilette appear to us to confirm the opinions put forward by Mr. Crookes. The procedure which enabled us to change at will the direct movement to the right into an inverse movement to the left seems to agree with the arguments of this eminent chemist before the Royal Society of London. We obtained the normal rotation under the action of radiant heat, but after having left the radiometer exposed for five minutes to a temperature of $45^{\circ}C$. we plunged it rapidly into a bath of cold water at $15^{\circ}C$. The rotation to the right ceased, the instrument stopped for a moment, and then began to revolve to the left with a rapidly increasing speed, which reached a revolution and a half per second. This inverse movement ceased almost as quickly as it had begun. At the end of half a minute the movement to the right re-commenced under the action of the solar rays which fell upon the absorbent surfaces of the radiometer in the midst of the liquid mass, and without the possibility of heating by conduction.

M. Fizeau, with reference to this communication, remarked that the conclusions of the author in favour of the existence of an impulsive force in the rays of light, seemed to him to require the most formal reservations. The ingenious instrument of Mr. Crookes seemed to be in reality a thermic apparatus, in which the rotation, with all its circumstances, may be simply ascribed:—(1) To a slight excess of temperature acquired by the discs as compared with the ambient medium under the influence of light. (2) To the inequality of the emissive and absorbent powers of the two opposite surfaces of each disc, the one blackened and the other polished. (3) To the inevitable presence in the apparatus of a small quantity of elastic fluid (gas or watery vapour), the layers of which close to the blackened surface may acquire a slight excess of elastic force sufficient to propel the discs whose mobility is extreme. Certain inverse movements temporarily produced by cold will be the analogous results of the same causes. Moreover, M. Fizeau, at the request of several members of the Academy, made in their presence, at the end of the sitting, certain experiments with the instrument. He showed that if a stream of solar rays, limited by a screen, were thrown upon the disc so as to strike merely the polished surfaces of the discs the rotatory movement was still produced, but in such a direction that each disc moved to meet the solar rays instead of retreating from them, as ought to take place if the motion were the result of an impulsive power of light. Previous experiments have shown, further, that this result does not depend on accidental reflections in the interior of the apparatus.

Charge assumed by the Disc of the Electrophorus.—M. E. Douliot.—The charge received by the disc, and which it carries away when raised by its isolating handle, is proportional to its radius.

Theory of Spectra; Observations on the Last Communication of Mr. Lockyer.—M. Lecoq de Boisbaudran.—Reserved for insertion in full.

Constitution of Propylenic Monochlorhydrins, and on the Law of Addition of Hypochlorous Acid.—M. L. Henry.—Not suitable for abstraction.

Quino-acetate of Calcium.—M. E. Gundelach.—The author examining a commercial quinate of calcium found that it was a double salt, formed of equal molecules of quinate and acetate of lime.

No. 23, June 5, 1876.

Thermic Formation of Ozone.—Ozone is a body formed with absorption of heat, which it evolves in its oxidising actions—a fact which explains the superiority of its energy to that of ordinary oxygen. This excess of heat or of energy has been stored up under the influence of electricity, an excess remarkable because we have here the formation of a body more condensed than that from

which it is produced, although condensation, in general, causes the liberation and not the absorption of heat, as takes place here. This is probably the only instance of a gas supposed to be simple and yet capable of presenting two distinct isomeric modifications in the gaseous state.

Absorption of Free Nitrogen by Organic Matters at Ordinary Temperatures.—M. Berthelot.—The author finds that free nitrogen is absorbed at ordinary temperatures by organic compounds under the influence of the electric *effluve* (silent discharge). He insists on this new cause of the fixation of atmospheric nitrogen in nature. It produces condensed nitrogenous compounds belonging to the class of the humic principles. However limited may be the effects at each moment, and on each particular spot of the earth's surface, they may nevertheless become considerable, in virtue of the extent and continuity of a reaction universal and never ceasing.

Origin of Organic Ferments.—M. L. Pasteur.—This paper is an extract from a work about to appear under the title "Etudes sur la Bière." The author combats M. Fremy's hypothesis of "hemiorganism," and quotes Dr. Tyndall's remarks on the writings of Dr. Bastian.

Examination of the Possible Mechanical Action of Light: Study of the Radiometer of Mr. Crookes.—M. A. Ledieu (continuation).—The author having explained his theory to M. Fizeau, this eminent academicien proposed an experiment by polarising a pencil of rays. In this manner, in fact, in accordance with his theory, we ought to obtain a minimum impulsions, or none at all when the plane of polarisation is made to pass along the axis of the radiometer. On the contrary, the maximum impulsions should be obtained at 90° from the first position. This experiment was made with an excellent instrument by M. Alvergnyat, but it gave no conclusive result. M. Fizeau then caused an ordinary pencil of rays to fall exclusively upon the blackened discs, and thus obtained a movement more accelerated than when the pencil fell at once upon both kinds of surfaces. He then operated in an analogous manner upon the bright surfaces, taking care to incline the pencil of rays so that no reflection might be thrown from the polished surfaces upon the black ones. The instrument continued to revolve, but with a reduced speed. This latter experiment would lead us to condemn all radiant influence, since this would attract in one case and repel in the other. The author's theory would therefore seem confounded by such a result, as well as every other explanation based upon the doctrine of emission. But on examining more closely, we are led to remark that in all the experiments related there is reflection of light upon the glass of the globe, and that, besides, when these rays are polarised, the plane of polarisation, after reflection, is no longer presented in the same direction as regards the faces of the discs. We must then conclude that further experiments are absolutely required to elucidate the question. The author, then, quoting the opinion of M. Fizeau, given in the present number of the CHEMICAL NEWS, continues—"This opinion, emanating from so distinguished a *savant*, must assuredly be taken into high consideration. Nevertheless, considering the regularity, the definite character, and the certainty of the revolution of the instrument, always in one and the same direction, the explanation of M. Fizeau does not satisfy us entirely, and the debate does not seem to be closed. He then suggests the following experiments:—Illuminate an ordinary radiometer, i.e., with discs alternately polished and blackened in the direction of its axis. The instrument ought to revolve in the same direction as when the pencil of rays illuminates the axis vertically, and the rotation even ought to be accelerated. Second. Construct an apparatus all the discs of which shall be left bright so as to reduce to a minimum the influence of the reflections upon the glass; then to throw a pencil of rays upon the disc situate on one and the same side as relates to the axis of the instrument. If the rotation is really due to the mechanical action of light the instrument will turn as if the discs were repelled by

the luminous rays. M. Ledieu does not hold that the movements of the earth, as a whole, can be effected by the solar radiations. He considers, however, that we have here a very natural explanation of the form of the tails of comets.

Report on several Memoirs by M. Allard relating to the Transparency of Flames and of the Atmosphere, and to the Visibility of Lighthouses with Flashing Lights.—MM. Jamin, Puiseux, and E. Becquerel.—M. Allard finds that the luminous intensity of the flames of lamps with concentric wicks increases more rapidly than the consumption of oil, and equally with the visible surface. The mean value of the coefficient of the transparency of flame, for a thickness of 1 centimetre, is expressed by the number 0.80.

Law of Dulong and Petit.—M. A. Terreil.—M. Terreil holds that there are only two phases when bodies possess their true absolute specific heat. The first of these is the moment when the body is in the gaseous state, and the other that when it has lost this state, no matter whether it has become liquid or solid. He admits, besides, that at the moment of these two phases the forces which modify the absolute specific heats have not yet come into action. In order to distinguish the specific heats, as he understands them, from the admitted specific heats, he gives them the name of chemical specific heats. He finds that the specific heat of bodies doubles when they cease to be gaseous.

Perturbing Influence of Neighbouring Masses on the Form and the Disposition of Crystals.—M. Ch. Brame.—Not adapted for abstraction.

Inconvenience of Ropes of Copper Wire as Lightning Conductors.—M. R. Francisque-Michel.—The author holds that a lightning-conductor should have at least a section of 350 to 400 square millimetres.

Influence of Certain Salts of Lime on Saccharimetry.—M. A. Müntz.—The author concludes that the rotatory power of cane-sugar in presence of a given salt is sensibly constant for one and the same quantity of salt dissolved in one and the same volume of liquid, whatever may be the ratio of the salt to the sugar. The decrease of rotatory power is, up to a certain point, proportional to the quantity of salt dissolved.

Derivative of Acetyl-acetic Ether: Oxy-pyrotartaric Acid.—M. E. Demarçay.—Not suited for abstraction.

Combustion of Organic Matters under the Double Influence of Heat and Oxygen.—M. D. Loiseau.—For the complete combustion of volatile products it is necessary to operate in tubes whose interior diameter is so much the greater as the current of oxygen is more feeble.

Metallisation of Organic Bodies to render them fit to receive Galvanic Deposits.—M. P. Cazeneuve.—The author saturates the bodies in question with alcoholic nitrate of silver, which is then reduced by the solar light, or preferably by means of mercurial vapours.

Determination of Sulphuric Acid and Soluble Sulphates by means of Standard Solutions.—M. H. Pellet.—The author first precipitates the sulphuric acid by chloride of barium in excess, precipitates the excess of chloride of barium with yellow chromate of potash, and finally determines the chromate with standard solutions of protochloride of iron and permanganate of potash.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 7, June 15, 1876.

The Radiometer of Mr. Crookes.—M. Trouve.—I am desirous of knowing if Mr. Crookes has given a theory, or rather a logical definition, of the movement of his instrument in presence of light. On my part, I find no satisfactory explanation of this phenomenon save in a comparison with the theory of the electric mill. I ascribe, therefore, the movement to the diffusion of the fluid, and

not to a direct action exerted by light. What confirms me in this view is that this apparatus, which works as well with light as with dark heat, behaves with the latter just as a secondary couple behaves with electricity—that is to say, it gives back to a certain extent the mechanical action which it has received. If the radiometer is exposed to the sun, it takes an accelerated movement in one direction. But if this motion is abruptly stopped, and the instrument withdrawn from the source of light, it immediately begins to turn in the opposite direction.

Reimann's Farber Zeitung,
No. 21, 1876.

M. Prinvault has communicated to the Industrial Society of Rouen a process for obtaining a scarlet, the shade known as Persian red, from the chromate of lead. If carbonate of lead is digested with a cold solution of 1 part of the neutral chromate of lead in 50 of water, so that two equivalents of the former may react with one of the latter compound, there is obtained in two days a crystalline precipitate of basic chromate of lead. If the supernatant liquid is boiled, it evolves carbonic acid, since bicarbonate of potassa is present, and is converted into a solution of potash, which decomposes a part of the red precipitate, so that it takes a violet-red colour, whilst the liquid turns yellow. The precipitate is too dull to be of any value. If it is washed with water, and treated with 4 per cent of its weight of dilute sulphuric acid (1 in 100), adding the acid slowly and stirring, and then neutralising with a dilute solution of soda, there is formed a mixture of sulphate and of basic chromate of lead, the colour passing into a fiery vermillion. The quantity obtained is about equal to the carbonate of lead employed. According to M. Prinvault, nitric or acetic acid may be used instead of sulphuric, but not hydrochloric. The proportions he employs are 25 grms. neutral carbonate of lead, with 10 grms. neutral chromate of potassa. He digests two days in the cold, boils for half an hour, filters, washes the precipitate, and treats it with 1 grm. of sulphuric acid diluted with 100 grms. of water. The new red cannot be fixed with albumen on account of its crystalline texture. It may, however, be possible to convert chrome orange into Persian red upon the fibre.

The Berlin daily papers are very busy with another supposed case of poisoning from the lining of a hat. A Government official, shortly after buying a new hat, was troubled with a very disagreeable eruption on his forehead. The affair is in the hands of the authorities.

Purpurin.—According to F. de Lalande's French patent purpurin may be obtained as follows:—100 parts alizarin and 100 of dry arsenic acid are heated with 1000 parts of sulphuric acid to 150°, until a sample taken out gives a deep red colour with soda. He then dilutes with 30 volumes of water, heats, and filters. The residue is used for dyeing. Instead of arsenic acid may be used antimoniac acid, peroxide of manganese, or stannic acid.

Rosenstiehl has obtained a colouring matter in yellow metallic lamellæ by acting upon dry artificial alizarin with nitrous acid. With alumina it dyes yellow, and with iron mordants a red-violet, both which colours can be brightened with boiling soap lyes. It dyes best in distilled water or with addition of acetate of lime. Rosenstiehl considers it as nitro-alizarin.

MISCELLANEOUS.

University of London.—The following is the list of the candidates who have passed the recent D.Sc. Examination:—Branch IV. (*Inorganic Chemistry*).—T. Carnelley, Owens College; F. Clowes, Royal College of Chemistry and private study. Branch VI. (*Electricity, treated Experimentally*).—J. G. MacGregor, private study. Branch XII. (*Vegetable Physiology*).—E. B. Aveling, University

College. Branch XVI. (*Logic and Moral Philosophy*).—P. K. Ráy, University and Manchester New Colleges, and University, Edinburgh.

Mineralogical Society of Great Britain and Ireland.—A local meeting of the Cornish members was held at the Public Rooms, Redruth, on Saturday, July 1, when the following papers were read, the chair being taken by Dr. C. Le Neve Foster, Her Majesty's Inspector of Mines for the district:—"On a New Mineral from West Phœnix Mine," by J. H. Collins, F.G.S., with remarks by Dr. C. Le Neve Foster, B.A., &c. This is a hydrous phosphate of alumina and copper, resembling turquoise, but containing much more phosphoric acid and water and less alumina. Mr. Collins has called it Henwoodite, after the late W. Jory Henwood, F.R.S. "On the Occurrence of Pyrophyllite at Brookwood, and on New Mineral Localities in Devon and Cornwall," by Dr. C. Le Neve Foster, B.A., &c. "On the Oxide of Iron enclosed in Calcite and Quartz, at the Mwyndy Mines, Glamorgan-shire," by Wm. Vivian. "On the Occurrence of Pharmacosiderite Scorodite and Olivenite in Greenstone, at Terras Mine, St. Stephens," by J. H. Collins, F.G.S. Mr. B. Kitto, F.G.S., was elected Local Secretary for Cornwall, subject to the approval of the Council.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved continuous horizontal apparatus for washing or absorbing gas or vapours, or for distilling liquids. W. L. Wisc, Chandos Chambers, Buckingham Street, Adelphi, Middlesex. (A communication from E. Soler, Brussels.) March 5, 1875.—No. 820. The apparatus consists in a closed tank or reservoir divided into compartments which communicate one with the other by holes or apertures made in the partitions, the lower holes being for the passage of the liquid, and the upper holes for the passage of the gas or vapour from one end of the apparatus to the other. Over each of the holes for the passage of the liquid into the inner compartments is affixed a tube or pipe bent upwards, and rising vertically to rather above the intended level of the liquid; and over each of the holes for the passage of gas or vapour into the inner compartments is affixed a gas- or steam-tube or pipe of less diameter than the liquid pipes above referred to, and the said gas- or steam-tubes or pipes extend downwards, and by their lower ends, which are serrated, dip into the liquid pipes respectively, being concentric thereto. The liquid is fed into the apparatus from a separate feed-tank, in which the liquid is kept constantly at the required level by a float and suitable valve. The said liquid passes from the feed-tank into the apparatus, and consecutively through each of the compartments, by passing into each of the liquid pipes, and being projected therefrom by the action of the steam or gas issuing from the steam- or gas-pipes.

Improvements in furnaces for metallurgical operations, which improvements may also be applied to steam-boilers and other furnaces. A. Parkes, Gravelly Hill, Erdington, Warwick. March 6, 1875.—No. 841. This invention consists essentially of a chamber or generator in which gaseous fuel, consisting mainly of carbonic oxide, is generated, the gaseous fuel being conducted over a hollow bridge or hot-air flue into a reverberatory chamber in which copper is smelted, or the puddling of iron, or other like metallurgical operation is carried on. The hot air from this bridge or flue mixing with the gaseous fuel effects its combustion, and produces an intense heat in the reverberatory chamber. The air supplied to the hollow bridge or hot-air flue is heated by passing through the walls of the generator, which are reticulated or honeycombed. The waste heat from the reverberatory chamber may be utilised by being passed to a second or cementing chamber, and from thence to a boiler for the generation of steam. The gas generator and hot-air bridge may be applied to steam boiler and other furnaces unconnected with metallurgical furnaces.

Improvements in the manufacture of "consolidated coal." F. C. Danvers, Argyle Road, Castle Hill, Ealing, and J. H. Landon, Turner Square, Hoxton. March 11, 1875.—No. 897. The novelty of this invention consists of the use of farina or starch in the manufacture of artificial fuel (or consolidated coal) without water, the starch being boiled in tar or other mineral or vegetable oil; also in the melting of the pitch—where that material also is used—in tar, before being mixed with the small of coal, culme, or breeze.

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Absorbing Power of Charcoal.—Can one of your readers oblige me with a simple method for ascertaining the absorbing power of charcoal samples?—DISINFECTOR.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 868.

ON THE ACTION OF CERTAIN KINDS OF FILTERS ON ORGANIC SUBSTANCES.

PART III.

By J. ALFRED WANKLYN.

A SOLUTION of hydrochlorate of morphia in common London water was prepared by taking 1·320 grms. of hydrochlorate of morphia, dissolving it in water, and diluting the solution to 10 litres. In this manner a solution containing 0·132 grm. of the hydrochlorate per litre of water was obtained. Submitted to the ammonia process this solution was found to yield 2·60 m.grms. of albuminoid ammonia per litre. Five litres of this solution were then allowed to run through the same silicated carbon filter which had been employed for the experiments on quinine described on p. 4, and the 5 litres of filtrate were then thrown away. In this manner the most simple displacement of the liquid occupying the pores of the filter was ensured. About 5 more litres of the solution were next run through the filter, and the filtrate was examined with the following results:—

Milligrammes of albuminoid ammonia per litre of liquid—No. 1, 0·06; No. 2, 0·04. Showing how completely the filtration had removed the morphia from the solution.

As a further corroboration, advantage was taken of the reducing properties possessed by morphia, which decolourised standard solution of permanganate, and which may be titrated with such a solution.

Before submitting it to filtration 100 cubic centimetres of the solution of morphia reduced 8·5 c.c. of decinormal* permanganate solution.

After filtration 100 c.c. of the liquid did not reduce any appreciable quantity of the permanganate. Thus it has been proved that one single filtration through a thickness of 6 inches of "silicated carbon" is sufficient to remove morphia from a solution containing 132 m.grms. of the hydrochlorate of morphia in one litre of water (or 9·24 grains per gallon.)

Having arrived at this result, I next endeavoured to reach the limit of strength capable of being dealt with by these filters. I dissolved 2·739 grms. of hydrochlorate of morphia in 3 litres of distilled water, thereby getting a solution containing 913 m.grms. of that salt per litre of water (or 63·91 grs. per gallon.)

This solution, as will be seen, is capable of decolourising decinormal permanganate solution at the rate of 59 c.c. of permanganate per 100 c.c. of the morphia solution.

It was poured on a very small silicated carbon filter; the first half of the filtrate was rejected and the second half examined. The filtrate was at first found to contain much morphia, but after making it pass and re-pass through the filter the morphia was so far reduced in quantity that 100 c.c. of the filtrate decolourised only 2 c.c. of decinormal permanganate, showing that about 3/4ths of the morphia had been absorbed by the filter. To attain this result, five or six passages through the filter were required.

Until I break up the filter and weigh the fragments of the cake, I cannot say with accuracy how much silicated carbon has been required to absorb the morphia. Roughly, however, the weight of the cake may be set down as 1000 grms. and, at that rate, 1000 grms. of silicated carbon is capable of absorbing at least 2 grms. of hydro-

chlorate of morphia. I propose, however, to make accurate determinations of the extent to which "silicated carbon" may be loaded with morphia.

I am continuing the experiments, and, in the meantime, I cannot help pointing out how completely my experiments have discredited the dictum that filtration through thick filters can only remove suspended matter.

A STUDY OF CHLORINE SUBSTITUTION.

By SAMUEL E. PHILLIPS.

If modern chemistry gained a signal triumph over the great Berzelius in the notable contention, *re* Chloracetic Acid, it would appear that very ignoble results have attended the victory.

Abandoning the untenable ground then taken, it would now appear that hydrocarbons, and their oxy- or other derivatives, subjected to the action of chlorine, evince, among other multiple or additive results, at least two isomeric substitutional changes—one by which the hydride becomes a chloride, leaving the radical untouched; the other by which one H of the radical is replaced by one of Cl.

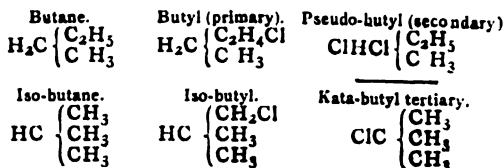
Hydride of acetyl becomes, in one case, acetyl chloride; in the other, chloracetic hydride—



One necessarily simple and unique, the other would doubtless vary isomerically, as the radical may have a more complex genesis.

Prof. Odling has treated this subject, but not with his accustomed felicity and clear penetration (see *Phil. Magazine*, March, 1876, "On the Formulation of the Paraffins and their Derivatives"):—"By the replacement of one Cl for one H a great variety of paraffins are attainable, as C_3H_7Cl , C_4H_9Cl , &c., the residues constituting the paraffin or alcohol monad radicals, propyl, butyl, amyl, &c.

"But this action gives rise to at least two distinct isomers, and a study of their formative and transformative reactions leads to the conclusion that the difference between them depends upon whether they result from a substitution of the introduced radical for the H of a methyl, or of a methylen residue; the paraffin radicals resulting in this way from the introduction of a foreign radical in the place of H, &c., affording the means for their classification. Thus:—

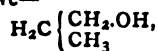


Whether residues are synonymous with radicals, and whether both are tri-, di-, mono-, or anhydric, and also tri-, di-, and mono-atomic, does not clearly appear from the context.

How purely visionary or hypothetical these fundamental conceptions are does not appear to have disturbed the Professor at all. An alcohol may be considered a water derivative—

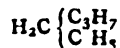


or a paraffin derivative—



but these condensed forms are very optional, and must be referred to their fundamental basis.

Pentane, for instance, may be considered a propyl-methyl-methane—

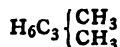


* This solution contained 0·4 milligramme of active oxygen per cubic centimetre.

or a butyl-methane, $\text{H}_3\text{C.C}_4\text{H}_9$, or propyl-ethane, $\text{H}_3\text{C}_2\text{C}_3\text{H}_7$, or diethyl-methane—



or dimethyl-propane—



and as far as the nature of the paraffin is concerned one is as correct as the other; but they are all condensed expressions of the one true formula—



We stay not to discuss such elements of difficulty and hypothesis, but we do ask, What is the outcome thereof in the region of practical manipulation?

The most simple and fertile distinctions, appreciable even to the amateur mind, are wholly ignored, while learned Professors are discussing methylen dispositions and polyatomic peculiarities worthy of mediæval metaphysics.

That Prof. Odling is amiably and earnestly desirous to extend our knowledge of isomerism no one will doubt; but, standing before his methylen basis of terminology and classification, there are simpler matters, more within reach, which demand a juster and clearer appreciation.

When chloro or nitro substitutions subsist isomerically, the A B C of the matter is to determine where the chlorine or other radical has alighted, "whether in a methyl or in a methylen residue," &c.

Per contra, we hold that in such cases, whenever two or three isomers subsist, as a general rule, the isomeric differences are due to the radical itself, and equally subsist when the Cl or (NO_2) is withdrawn; and that the A B C of the matter is to distinguish between a chloride and a chloro-radical; and, further, that this distinction is a real one in fact, as well as a primary one in chemical ethics, extending also to the H of the hydride.

Some chemists take great pains to insist that in methane no difference is appreciable among the H elements; but, taking methane and mellissane as extremes, may we not fairly ask for some appreciation of the volumetric and other differences due to the H elements?

This may not be capable as yet of absolute demonstration, and there may be difficulty in isolating the radicals without dedoublement or condensation; but the hypothesis is deserving of respect and further research, that the 6r H elements of mellissyl are condensed into one volume; and that the added one H of the hydride or chloride doubles the entire volume.

If chemists can distinguish between the atomic volumes (solid) of O = 12.2 in acetyl, and O = 7.8 in alcohol, surely they may be able to appreciate the difference between H in methyl or mellissyl and the H of their hydrides, seeing that one is, perhaps, one hundredfold more condensed than the other.

And similarly with the chlorine of chloracetyl, as compared with that of acetyl chloride.

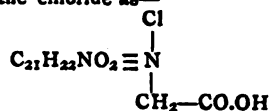
Whether we have ammonia, trimethyl ammonia, or triethyl ammonia, who is there that doubts that these condensations do really represent so many H equivalents, both chemically and volumetrically; and whether this hypothesis in all its bearings will pierce the clouds of prejudice, and ripen into true theory is not at all the present question, which is rather as to what advantages have accrued from a studied disregard of the plainest facts, and in illustration thereof we confine a few remarks to chloracetic acid.

At the outset, we may assume for the elements so-called at least two isomeric forms:—

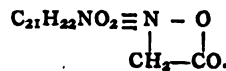
The true chloracetic acid, $(\text{C}_4\text{H}_2\text{ClO}_2)\text{O.HO} = \text{C}_4\text{H}_3\text{O}_4\text{Cl}$, glycolyl chloride, $(\text{C}_4\text{H}_3\text{O}_4)\text{Cl} = \text{C}_4\text{H}_3\text{O}_4\text{Cl}$.

Dr. P. Romer digested a mixture of mono-chloracetic acid with strychnine at 180°C . for several hours, and obtained a new base: that he combined with platonic chloride, giving the salt $\text{C}_{23}\text{H}_{24}\text{O}_4\text{NHCl.PtCl}_2$.

He notates the chloride as—



The free base—

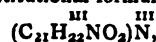


In simplest terms I should say theoretically—

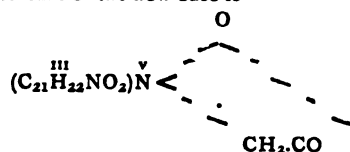
Glycollic acid + strychnine - $2\text{HO} =$ the new base.

A few weeks before this M. Strecker had discovered the same result with fuller particulars, calling the new base "Glycol-strychnine," which it is not (CHEMICAL NEWS, vol. xxiv., p. 263).

"Taking the constitutional formula of strychnine as—

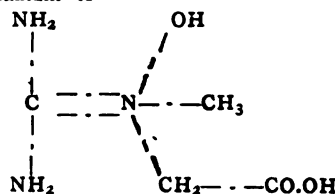


then the formula of the new base is—



Within that short interval M. Huppert falls into the same error, and by digesting "monochloracetic acid with methyl-guanidin to 120° for twelve hours," obtains a crystalline result containing 2HO more than kreatin.

"The constitutional formula of the substance 'glycolyl-methyl-guanidin' is—



Kreatinin has the elements of $(\text{C}_6\text{H}_3\text{O}_2)\text{CyH}_4\text{N}_2$
+ $2\text{HO} =$ kreatin $(\text{C}_6\text{H}_5\text{O}_2)\text{CyH}_4\text{N}_2$
+ $2\text{HO} =$ new base $(\text{C}_6\text{H}_7\text{O}_2)\text{CyH}_4\text{N}_2$.

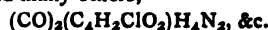
By the reaction of "monochloracetic acid" upon morphia the author obtained a crystalline base belonging to the same class of bodies.

Methalcohol + morphia - $2\text{HO} =$
 $\text{C}_{34}\text{H}_{18}\text{O}_6$
 $\text{C}_4\text{H}_3\text{O}_2$ } $\text{C}_{38}\text{H}_{21}\text{O}_8\text{N}$, CODEIA

Acetic acid, }
monochloracetic acid, } + morphia - $2\text{HO} =$
or acetic chloride }
 $\text{C}_{34}\text{H}_{18}\text{O}_6$
 $\text{C}_4\text{H}_3\text{O}_2$ } $\text{C}_{38}\text{H}_{21}\text{O}_8\text{N}$, acetyl morphia

Glycollic acid or }
glycolyl chloride } + morphia - $2\text{HO} =$
 $\text{C}_{34}\text{H}_{18}\text{O}_6$
 $\text{C}_4\text{H}_3\text{O}_2$ } $\text{C}_{38}\text{H}_{21}\text{O}_{10}\text{N}$, glycolyl morphia]

In the reactions with true chloracetic acid there is a tendency to elimination of the Cl to a normal acetyl substitution, but this is not always the case, as with chlor-acetyl urea, and many others,—

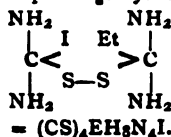


M. Claus similarly trips in a recent study of sulphurea combinations.

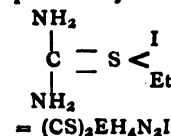
Urea "hydrochloride," $(\text{CO})_2\text{H}_4\text{N}_2\text{HCl}$
Sulphurea with ethyl iodide, $(\text{CS})_2\text{H}_4\text{N}_2\text{EI}$
" " acetyl chloride, $(\text{CS})_2\text{H}_4\text{N}_2(\text{C}_4\text{H}_3\text{O}_2)\text{Cl}$
" " monochloracetic acid, $(\text{CS})_2\text{H}_4\text{N}_2(\text{C}_4\text{H}_3\text{O}_2)\text{Cl}$

Now who does not see that these are indeed very normal and old fashioned combinations, since ammonia with ethyl iodide behaves strictly similar, a matter so well exemplified by Hofmann with the triamine rosaniline salts. Yet, strange to say, M. Claus claims new discovery, and he believes "these additive compounds are formed through the S molecules, as exemplified in the following formulæ:—

Disulphurea²ethyl-iodide.



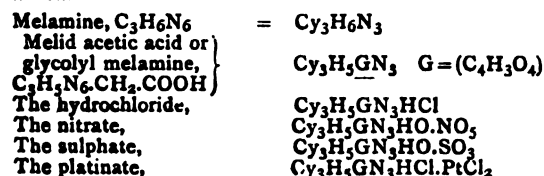
Sulphurea ethyl-iodide.



We have enlarged elsewhere on the same want of discrimination in respect of Armstrong's invaluable epitome of the science (see CHEMICAL NEWS, vol. xxxii., p. 2), and could give many other illustrations, but in utmost brevity we conclude with a recent discovery of "melid acetic acid." The others are curious, but this one is much more so, and the determination to make it an "acetic acid," involves an inverse audacity, which is as marvellous as it is racy. The idea is that one H of acetic acid is replaced by the radical or base "melamid;" but what is melamid?

Thanks to Hofmann we know pretty clearly what melamine is, both as a free base and as evinced in saltic types. Melamid, then, is said to be "melamine - H₂."

Now this feature may be very nice for a "residue," but it is very damnable for a radical or base, having a mono equivalence; and it irresistibly tempts us to turn the whole thing upside down, when, lo! the result is no acid at all, but a "glycolyl-melamine," behaving chemically and typically as a substituted melamine, and acetic acid probably has no existence, either before or after the reaction.



The sulphate or nitrate of a melid acid looks very much like a *melée* of confusion, whereas melamine gives mono salts exactly like those above.

Truly chemists stick at nothing in order to carry out their preconceptions, and in sight of such results one is tempted to ask *Cui bono*?

It may be urged that, admitting an acetyl body most normally gives an acetyl substitution, yet that exceptional cases of oxidation may transform that radical into glycolol (or oxacetyl). And some may further contend that the above *bizarre* types are models of atomic penetration and artistic ingenuity derived from a study of the formative and transformative reactions involved.

They are nothing of the kind; they are fanciful pleasantries, the legitimate offspring of fanciful hypothesis; and against this torrent of passing fashion I can do nothing but protest, and, with one leg in the grave, I can hopefully retire with the certain conviction that truth will be paramount, and that a better time is coming, when science will be more popularised, and simplicity of conception will no longer be tabooed as necessarily superficial knowledge.

The people may have much to learn, but the professors have much to unlearn. A wide demand for the bread of truth is increasing, and the people will not be satisfied with the pedantic stones of learned hypothesis.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 5.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLLUS, of Ludwigshafen.

For many purposes, especially in the manufacture of sugar, there is required a hydrochloric acid free from sulphuric acid, iron, and arsenic. Very various proposals have therefore been made for obtaining a pure acid from the arseniferous product. Thus, Houzeau,† in order to obtain the acid free from arsenic distils the crude acid, adding 0.3 grm. pulverised chromate of potash to 3 litres, and, in order to protect the arsenic acid produced by the liberated chlorine from the reducing action of the hydrochloric acid, he causes during the distillation a continued stream of a solution of chromate of potash of tenfold the strength to be added. The escaping hydrochloric acid gas is freed from the accompanying chlorine by means of copper turnings and is then conducted into water. This process, however, is scarcely applicable on the large scale, as chlorine is necessarily evolved in very considerable quantities, and its absorption by means of copper is somewhat costly. P. W. Hofmann,‡ of Dieuze, on the other hand, has successfully introduced the following method for purifying hydrochloric acid:—A vessel with a doubly perforated earthenware stopper is filled with hydrochloric acid to the extent of one-third, and sulphuric acid of sp. gr. 1.848 is introduced by means of a funnel capable of being closed. The hydrochloric acid gas, which is given off very regularly, is washed in a Woolf's bottle and absorbed by distilled water in a receiver.

The evolution of gas ceases as soon as the sulphuric acid has fallen to the sp. gr. 1.566, in which case it only retains 0.32 per cent of hydrochloric acid. The sulphuric acid thus diluted is either employed direct in the manufacture of sulphate of soda, or it is re-concentrated, the expense of which amounts to 1 franc per 100 kilos. As 100 kilos. of sulphuric acid thus yield 40 kilos. hydrochloric acid of sp. gr. 1.181, 100 kilos. of pure hydrochloric acid prepared by this process are 2½ francs dearer than the crude acid. Fresenius,|| however, remarks that the acid thus purified is not quite free from arsenic, the gas evolved containing arsenic at every stage.

Bettendorff§ prepares pure hydrochloric acid by utilising the fact that arsenious acid in a concentrated hydrochloric solution is thrown down by protochloride of tin as a brown precipitate composed of arsenic with 1.5 to 4 per cent of tin. He mixes the concentrated acid with a concentrated solution of stannous chloride, filters off the precipitate, and distils, thus obtaining an acid perfectly free from arsenic.

This is confirmed by Mayrhofer,¶ but Hager** adds that if all the arsenic is not removed by filtration the distillate again becomes arseniferous. Dietz treats the hydrochloric acid with sulphuretted hydrogen, whilst

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Houzeau, *Compt. Rend.*, lix., 1025. Wagner, *Jahresber.*, 1865, 251.

‡ P. W. Hofmann, *Ber. Chem. Ges.*, 1869, 272.

§ *Journ. Analyt. Chem.*, 1870, 64.

¶ Bettendorff, *Dingl. Pol. Journ.*, xciv., 253. Wagner, *Jahresber.*, 1869, 219.

¶ Mayrhofer, *Ann. Chem. Pharmacie*, clviii., 326.

** Hager, *Wagner Jahresber.*, 1872, 262.

Engel employs hyposulphite of potassium for the same purpose. Of all these processes that of P. W. Hofmann is probably the only one used on a large scale. The pure hydrochloric acid required in the sugar manufacture is chiefly prepared in certain small establishments which make their sulphuric acid from sulphur, or which have at command non-arseniferous pyrites, *e.g.*, at Saarau, in Silesia.

(To be continued.)

REDUCING ACTION OF PHOSPHINE.

PHOSPHINE (PH_3) exerts a powerful reducing action upon sulphuric acid (SO_2HO_2). When passed into the strong acid the gas is absorbed rapidly at first, without any visible change, but when the acid has become saturated, and the action of the gas is still continued, the acid rapidly becomes heated sufficiently to ignite the phosphine. If the sulphuret be kept cool by a stream of water and the gas passed into it in excess, reduction to sulphurous anhydride, SO_2 , with separation of sulphur takes place.

The action may be thus represented—



Hydric sulphide may be produced, but, if so, is decomposed immediately by the SO_2 .

If the action be continued sufficiently long, the acid being kept cool, it becomes so thick and viscid with the separated sulphur that the vessel may be inverted without its contents escaping.

W. R. H.

Royal College of Chemistry,
South Kensington, July, 1876.

THE EFFECT OF FLEXIBILITY ON THE WORKING OF CHEMICAL BALANCES.*

By B. S. PROCTOR.

HAVING expressed the opinion that the degree to which a balance beam bends under its load forms an element too important to be overlooked in any satisfactory theory of its sensitiveness, I made an examination of several beams, good and bad, that I might first ascertain the degree to which bending takes place, and then calculate the effect which that bending would have upon the turning of the beam.

I did not propose that my experiments should have any special accuracy, such as would be required in critical examination of the relative merits of two similar beams, but only that they should be trustworthy, as shewing that flexibility has an influence—an influence greatly to the disadvantage of badly-designed beams, and not entirely to be overlooked in those of ordinary construction, but which almost vanishes in the beam in which Mr. Bunge has combined the advantages of superior mechanical principles with unusually good material and excellent workmanship.

I commenced with a beam of no value—a common dispenser's box-end beam, made of brass, its length between terminal bearings being 6.7 inches and its weight 680 grs. I bound it down against the edge of a strong steel bar—a file, in fact—the box-ends forming the terminal supports of the beam, while the pressure was applied to the centre, and the bending estimated by the diminution of the distance between the centre of the beam and the bar. This movement was necessarily very small, and the value of the observations must depend upon the extent of this small movement being fairly estimated. After a few preliminary attempts the method I adopted was to cement of glass upon the bar projecting beyond its edge

towards the beam, and a piece of mica upon the beam projecting over the edge of the glass; the movement of the edge of the mica over the edge of the glass was observed by a microscope magnifying several hundred diameters, and measured on an ordinary scale of inches and fractions laid upon the microscope stage, and observed with the left eye, while the mica was observed with the right eye through the microscope.

The pressure representing the load was applied by means of a spring, as the observations were most conveniently made with the movements in the horizontal plane. The spring used was a pair of microscope pliers having a distance of half an inch between their points, and it was found by experiment that each one-sixteenth of an inch compression represented a pressure equal to nearly 500 grs.—sufficiently near for my purposes. This spring was held in place by pins in the board which carried the whole arrangement. I placed one end of the spring just in contact with the middle of the beam, while the other was free to receive pressure, the pressure being regulated by fixing a pin in the line of motion of the free end and at such a distance as limited the compression of the spring to the degree which was required to produce the pressure desired. When the pressure was 500 grs., that is, equal to 250 grs. in each pan, the flexure equalled $\frac{1}{1600}$ of an inch, and with four times the pressure the movement was $\frac{1}{400}$ inch, thus confirming the first observation. The observations were repeated many times, with only such differences in the measurements as would naturally result from the nature of the experiment.

The second beam operated upon was a German dispensing beam of better quality than the above. Being of a different shape, it was found more convenient to fix one end and the middle, and apply the pressure to the free end of the beam, using the spring in the same manner as before, but adopting a new arrangement for microscopic observation. A microscope slide cemented to the end of the bar had diamond scratches upon its upper surface; a similar slip laid upon it with diamond scratches upon its under surface; the end of the beam rested upon this upper slip of glass, and was made to adhere to it with cement. The diamond lines being on contiguous surfaces of glass were readily brought into a sufficiently good focus for work, but a lower power was necessary in consequence of the thickness of the glass through which the observation had to be made. A magnifying power of 125 linear was, however, readily applied and found quite sufficient for the purpose. A drop of oil interposed between the glass slips rendered the focusing more satisfactory, but the motion rather less free. When the pressure equalled 500 grs. in each pan, the bending thus observed equalled $\frac{1}{10000}$ inch, and when the pressure equalled 2000 grs. in each pan, the bending was, $\frac{1}{2500}$ inch. These flexures must be halved to compare them with those of the first beam.

The third beam examined was one of Oertling's, intended to carry 1000 grs. on each pan, and turn with $\frac{1}{100}$ of a gr. The examination was conducted in the same manner as the last. The bending with the equivalent of 1000 grs. in each pan was $\frac{1}{1500}$ inch, which observation, after being several times repeated, was further confirmed by doubling the pressure and finding that the flexure was also doubled.

Finally, Bunge's beam was examined in the same manner; being designed to carry 3000 grs. in each pan, and turn with $\frac{1}{10000}$ gr. it was not to be expected that flexure should be observed to a measurable extent with light pressures. I found them too small to be satisfactorily estimated with pressures less than 2000 grs. in each pan; under this load the bending was $\frac{1}{10000}$ inch.

The following table shows the above results in a convenient form for comparison. The beams are arranged in the order in which they were examined. Their order also coincides with the development of the mechanical principles upon which they have been designed, and indicates progressive improvement in their working qualities, the second being both longer and lighter, yet less flexible than

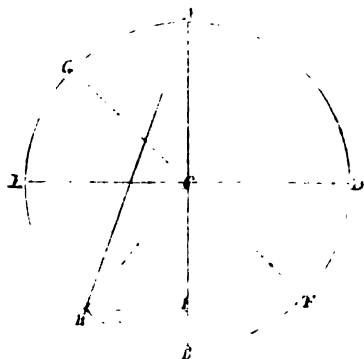
Dr. P. R. acid with strychnine the Newcastle-upon-Tyne Chemical Society. obtained a new chloride, giving the sa.

the first, as a consequence of the better distribution of its mass; so in comparing Bunge's beam with Oertling's we have both the weight and flexibility reduced to less than one-third, and the figures might have been still more in favour of Bunge's had it been practicable to make an equal reduction in weight upon those parts of the beam upon which there is little mechanical strain, but as in these parts there is not much excess in the old beams, there is not the same scope for reduction.

	Length in Inches.	Weight in Grains.	Bending Measured at one end under 1000 grs. in each Pan.	Fall in Centre of Gravity of Load.
Dispensing beam ..	6.7	680	0.00222	0.00111
Do. better quality ..	8.3	635	0.00200	0.00100
Oertling's balance ..	12.0	1786	0.00083	0.00041
Bunge's ..	5.0	616	0.00025	0.00012

In endeavouring to calculate the influence which the bending (as estimated by the preceding experiments) has upon the sensitiveness of the beam, I have not attempted to follow the Algebraic method as expounded by Prof. Aldis, but have contented myself with the methods of plane geometry and arithmetic with which I am more familiar, but which appear to me to tend to precisely the same conclusions.

If we take c as the centre of a circle, AB and ED its diameters, BD also representing a beam of which c is the pointer, two or three simple propositions will enable us to calculate the sensitiveness of the beam and the effect that bending has upon it. Let the lines AN , HB , and HI , be drawn, the latter being perpendicular to CB . IB will have the same ratio to HB that HI has to AN . Wherever the point H may be placed, these ratios remain



the same. Now, let CH be the pointer deflected by a weight added to the beam at D , and having swayed the beam to the position FO , the weight and the distance taken together represents a certain mechanical power. If it be a foot-pound, and the beam has come to rest at F , then the work performed by this power must be a foot-pound also. Foot-pounds being too large for present use, inch grains or inch m.grms., will be more convenient.

If, now, we suppose c to be the fulcrum, and the centre of gravity of the beam, 1786 grs. added to D and x gr. added to B , the length of the beam being 10 inches, the fall of D being $\frac{1}{10}$ inch, the deflection at B will also be $\frac{1}{10}$ inch—the fall of 1786 gr. $\frac{1}{10}$ inch = 1786 of an inch gr. The deflection at B being $\frac{1}{10}$ inch, is $\frac{1}{10}$ of the length AB , and for practical purposes at these small deflections also $\frac{1}{10}$ of the length of AN . Now, as IB bears the same ratio to this $\frac{1}{10}$ as this $\frac{1}{10}$ inch bears to AB (10 inches), the weight added to B has been raised vertically $\frac{1}{10}$ of $\frac{1}{10}$ of an inch, or $\frac{1}{1000}$, and as this work done equals

1786 of an inch gr., $\frac{1}{10}$ of a gr. must be the weight so raised. Now, suppose the beam to weigh 1000 grs., and that no weight had been added to B , while the same deflection of the pointer had taken place and the same work consequently had been performed, the centre of gravity of the beam must have been raised by the turning just so much as to equal 1786 of an inch gr., and that this may take place the centre of gravity must be as many times nearer the fulcrum as the weight of the beam is greater than that previously supposed to be acting at B . As its weight is $10,000$ times greater, its distance will be 10000 of CB (5 inches), or 0.002 inch. If it be admitted that the distance between the centre of gravity of the beam and the fulcrum must be so small under these circumstances, and smaller still when the beam is heavier of the same length, the amount of bending which I have obtained is sufficient to interfere with its sensibility; and the difference in flexibility between Bunge's beam and the forms at present in use in the laboratories, is sufficient to give Bunge's a distinct superiority in this respect.

In estimating the effect of the bending of the beam, it must be remembered that the centre of gravity of the beam does not fall to the same extent as the bending takes place, but only to a smaller extent, and an extent which it is not practicable to estimate; but the virtual centre of gravity of the load falls to the full extent of the bending.

In the above illustration, that of a beam weighing 1000 grs. with its centre of gravity 0.0005 below its fulcrum, and its end bearings on a line with its fulcrum when not strained, if we suppose a bending to take place when loaded such as takes place in the Oertling beam examined, then the resistance is increased from 1000×0.0005 to this product, $+ 2000 \times 0.0004$ —that is, the weight of the pans with their load multiplied by the fall which has taken place in their centre of gravity, leaving out of the question the falling in the centre of gravity of the beam due to its bending. Thus the resistance due to bending would bear to the original resistance the ratio of 8 to 5 .

Supposing the pointer of the Oertling beam to move 0.1 inch with 1786 gr., I calculate the centre of gravity to be 0.00027 below the fulcrum, and its resistance to the supposed movement would be thus multiplied by its weight 1786 grs. and the additional resistance due to bending would be 2000×0.00041 . By this calculation the resistance due to bending is to the original resistance as 82 to 48 .

Supposing the pointer of Bunge's beam to move 1 m.m. with 0.1 m.grm., I calculate the centre of gravity to be 0.00304 inch below the fulcrum, and its resistance consequently 600×0.00304 ; while 1000 grs. in each pan = 2000×0.00012 (the extent of its bending), gives the additional resistance consequent upon its bending under its load. The resistance due to bending is to the original resistance as 24 to 182 .*

Since the distance between the fulcrum and the centre of gravity may be indefinitely decreased, the sensitiveness of the beam may be indefinitely increased provided the mechanical defects of the beam do not stand in the way, but length and its consequence—either considerable weight or palpable flexibility—are prominent obstacles to this mode of increase of sensibility, and the palpable thickness of the knife edges is another obstacle. In the ordinary steel knife edges, however fine they may be at

* In a balance recently designed by Prof. Mendeleef, the length of the beam is rather less than Bunge's, and it is stated to turn with 1.10000 gr. when loaded with $15,000$ grs. I have not seen this balance, nor even a detailed description of it; such particulars as I have are quoted from the *Pharmaceutical Journal* of March 11, 1896. Mendeleef accomplishes this extreme sensibility by adding micrometer scales and cross threads at the ends of the beam, and a telescope for their observation—a refinement which was introduced by Prof. W. H. Miller, and which, while it greatly increases the delicacy of the observation, removes it beyond the sphere of convenient daily appliances. I had not seen any notice of Mendeleef's balance till after I had drafted my present communication.

first, they can scarcely be brought with pressure upon the agate planes without a palpable thickness being imparted to them.* Those I have examined had a thickness visible to the naked eye, while Bunge's, made of quartz crystal, I have not succeeded in seeing with the aid of a lens. I must admit that a fine edge would be much less readily seen in a material like crystal than in metal, but it must also be admitted that the greater hardness of the stone would give a permanence to the edge which a steel edge would not possess. Suppose we admit that in the crystal edges and planes the imperfections of a fulcrum are as nearly as possible eliminated—that the flexibility has been reduced to its smallest practical amount by the use of the girder form adopted by Bunge—that the sensitiveness is under our command by screwing up the centre of gravity, and that the quickness has been obtained by reducing the length of the beam, where lies the practical limit to the smallness of the weight which will turn the beam? Mathematics would teach us that any weight, however small, would turn the beam to some extent, and that the limit is the limit of our vision. This points to the last particular in which Mr. Bunge has improved upon the old models. Having secured movement by the means already pointed out, he has magnified the motion by increasing the length of his pointer, and this is of more importance than would at first sight appear, for it gives the principal advantages of a long beam without its failings, for the long pointer adds very little to the slowness of turning, and nothing to the flexibility.

In making these remarks I would not have it supposed that I am writing up the performances of Bunge's balance. I have simply endeavoured to understand and to explain by what principles the maker has obtained the very excellent results which we all admit.

I must also add, that while I have connected Oertling's name with a balance not equal to Bunge's, I do not imply that Oertling's workmanship is inferior; on the contrary, requiring for the sake of comparison to experiment upon a beam of the form in general use, I preferred to take one of Oertling's on the ground that his name was a guarantee of good quality.

NEW METHOD FOR THE DETECTION OF COPPER, CADMIUM, AND BISMUTH.†

By MALVERN W. ILES, Ph.D.,
School of Mines, Columbia College.

working upon the cyanogen compounds, the experimenter knows not what singular and unexpected results he may bring about at every step. That his results are often very highly characteristic is well proven by the beautiful shades of blue, green, red, white, yellow, and brown produced from this radical. Some of these tints are, however, very far from being beautiful; thus we have a dirty, dark yellowish brown. Other shades may be described as brownish yellow, reddish brown, brownish grey, deep reddish brown, yellowish brown, orange-yellow, and various shades of white.

The deportment of various reagents with the cyanogen compounds may give rise to products entirely nullifying the experimenter's theoretical considerations, but frequently highly characteristic of the element with which he is experimenting.

In illustration of the singular changes which cyanogen compounds undergo, I may cite the following:—Aqueous solution of cyanogen rapidly decomposes, giving ammonium oxalate, paracyanogen, a brown insoluble matter, and other products.

* Mendeleef says in the ordinary arrangement of steel knife edges upon agate bearings the wearing not only damages the stability of the balance but also quickly destroys its sensibility.

† A Paper read before the Chemical Section of the New York Academy of Sciences.—*American Chemist*.

Hydrocyanic acid can scarcely be preserved alone, even when enclosed in a carefully stopped bottle; it soon darkens, depositing a black substance containing carbon, nitrogen, and perhaps hydrogen: ammonia is formed at the same time, and many other products. Light favours this decomposition. Dilute solutions soon become turbid, but not always with the same degree of rapidity, some samples resisting change for a great length of time, and then suddenly solidifying to a brown pasty mass.

When hydrocyanic acid is mixed with concentrated mineral acids, as hydrochloric, the whole solidifies to a crystalline paste of ammonium chloride and hydrated formic acid.

On the other hand, when dry ammonium formate is heated to 392° F., it is almost entirely converted into hydrocyanic acid and water.

The experimenter may also produce, at any step, cyanides, cyanates; cyanic and cyanuric acids; hydrated cyanic acid, hydro-ferro and hydro-ferricyanic acids, or the combination of the same with bases. I might further cite as an illustration of these remarkable changes, that cyanic acid when mixed with water is decomposed almost immediately into acid carbonate of ammonium; that pure cyanic acid on standing soon changes spontaneously, with a sudden elevation of temperature, into a solid, white, opaque, amorphous substance, called cyamelide. Furthermore, this curious body has the same composition as cyanic acid, but is insoluble in water, alcohol, ether, and dilute acids; it is soluble in strong oil of vitriol by aid of heat, with the evolution of carbonic acid and the production of ammonia. When boiled with a solution of caustic alkali it dissolves with the disengagement of ammonia, and a mixture of cyanate and cyanurate of the base generated. By dry distillation cyamelide is again converted into cyanic acid.

The artificial production of urea, a product of the human body, from ammonium cyanate, marked a new era in organic chemistry, and constitutes one of Wöhler's greatest discoveries.

Urea is decomposed, by the aid of heat, into cyanuric acid and ammonia. Cyanuric acid is changed by a very high temperature into cyanic acid. The study of cyanic and cyanuric ethers, which were discovered by Wurtz, has led to very important and curious results.

In this connection may be mentioned that curious body, fulminic acid, which is isomeric with cyanic and cyanuric acids; also fulminuric acid, isomeric with cyanic, fulminic, and cyanuric acids. In short, cyanogen and its compounds are to me a perfect marvel! It is, I think, one of the main keys to the intricate secrets of Nature, and when its behaviour is properly understood will unlock the door to various phenomena in organic chemistry now inexplicable.

While working upon the ferro- and ferri-cyanides of nickel and cobalt, with reference to a qualitative detection of nickel in the presence of cobalt, I was led to study the reactions of various other metals with the reagents above mentioned. Some of these reactions were so striking that a qualitative separation immediately suggested itself. For example, a solution of potassium ferricyanide (1 part salt to 38 parts water) yields with copper a dirty yellowish brown precipitate, with bismuth a yellowish brown, and with cadmium a light yellow precipitate. The copper and cadmium ferricyanides were found to dissolve entirely in potassium cyanide in slight excess, while the bismuth separated in white flocules. Using this fact as a basis, my mode of procedure may be briefly stated as follows:—Proceed with the H₂S group up to the point where Cu, Cd, and Bi are obtained in solution together, as usual, care being taken not to have too large an excess of free acid; then proceed with the following scheme:—

Scheme for Cu, Cd, and Bi.

Add 6KCyFe₃Cy₆ to slight excess; next add KCy and gently warm—the Cu and Cd are dissolved, while the Bi remains as a hydrate; filter.

RESIDUE.	FILTRATE. Contains Cu and Cd; divide into equal parts.	
	Solution A.	Solution B.
White flocculent ppt. = $\text{Bi}_2(\text{HO})_6$. Confirm on charcoal by use of the "Bismuth Flux" ($\text{KI} + \text{S}$).	Add a few drops of $(\text{NH}_4)\text{HO}$, then $(\text{NH}_4)_2\text{S}$ and gently warm; a yellow ppt. = CdS .	Add $\text{HCl}(\text{dil})$ to strong acid reaction; a reddish ppt. = Cu_2FeCy_6 .
Bi.	Cd.	Cu.

The basis of the above scheme may be stated as follows:—

1. The complete precipitation of copper, cadmium, and bismuth by potassium ferricyanide.
2. The solubility of copper and cadmium ferricyanides in potassium cyanide.
3. The decomposition of bismuth ferricyanide into bismuthic hydroxide by the action of potassium cyanide.
4. The insolubility of cadmium sulphide and the solubility of cupric sulphide in potassium cyanide.
5. The insolubility of copper ferrocyanide and the solubility of cadmium ferrocyanide in hydrochloric acid.

The Chemical Reactions.

- (a). $6\text{KCy} \cdot \text{Fe}_2\text{Cy}_6 + \text{Bi}_2(\text{NO}_3)_6 = \text{Bi}_2\text{Fe}_2\text{Cy}_{12} + 6\text{KNO}_3$.
White.
- (b). $6\text{KCy} \cdot \text{Fe}_2\text{Cy}_6 + 3\text{Cu}(\text{NO}_3)_2 = \text{Cu}_3\text{Fe}_2\text{Cy}_{12} + 6\text{KNO}_3$.
Yellowish white.
- (c). $6\text{KCy} \cdot \text{Fe}_2\text{Cy}_6 + 3\text{Cd}(\text{NO}_3)_2 = \text{Cd}_3\text{Fe}_2\text{Cy}_{12} + 6\text{KNO}_3$.
White.
- (d). $\text{Bi}_2\text{Fe}_2\text{Cy}_{12} + 8\text{KCy} + 6\text{H}_2\text{O} = 2\text{Bi}(\text{HO})_3 + 2(4\text{KCy} \cdot \text{FeCy}_2) + 6\text{HCy} + \text{Cy}_2$.
- (e). $\text{Cu}_3\text{Fe}_2\text{Cy}_{12} + 14\text{KCy} = 3[(\text{KCy})_2 \cdot \text{CuCy}_2] + 2(4\text{KCy} \cdot \text{FeCy}_2) + \text{Cy}_2$.
- (f). $\text{Cd}_3\text{Fe}_2\text{Cy}_{12} + 14\text{KCy} = 3[(\text{KCy})_2 \cdot \text{CdCy}_2] + 2(4\text{KCy} \cdot \text{FeCy}_2) + \text{Cy}_2$.
- (g). $(\text{KCy})_2 \cdot \text{CuCy}_2 + 4\text{HCl} = \text{CuCl}_2 + 2\text{KCl} + 4\text{HCy}$.
- (h). $2\text{CuCl}_2 + 4\text{KCy} \cdot \text{FeCy}_2 = \text{Cu}_2\text{FeCy}_6 + 4\text{KCl}$.
- (i). $\text{CuS} + 4\text{KCy} = (\text{KCy})_2 \cdot \text{CuCy}_2 + \text{K}_2\text{S}$.
- (j). $(\text{KCy})_2 \cdot \text{CdCy}_2 + (\text{NH}_4)_2\text{S} = \text{CdS} + \{(\text{KCy})_2(\text{NH}_4)_2\text{Cy}_2\}$.
- (k). $\{(\text{KCy})_2(\text{NH}_4)_2\text{Cy}_2\} = 2\text{K}(\text{NH}_4)\text{Cy}_2 \text{ or } \{2\text{KCy} - 3(\text{NH}_4)\text{Cy}_2\}$.

I proved by experiment that when copper, cadmium, and bismuth ferricyanides are treated with an excess of KCy , potassium ferrocyanide is formed (see Equations d, e, and f).

It is difficult to say whether Equations g and h represent the exact chemical change that takes place, since there is a discussion in regard to the compound called "Hatchett's Brown" or copper ferrocyanide. Reindel gives its composition as $\text{Cu}_3\text{K}_2\text{FeCy}_{12}$ (see *J. Pr. Chem.*, ciii., 166), while this formula, is called in question by Wyruboff, who gives the formula Cu_2FeCy_6 , probably with 6 mol. H_2O (see *Bull. Soc. Chim.* [2], xii., 98; xiv., 145).

The qualitative reactions for cadmium and bismuth have always been a source of annoyance, and the valuable aid of the blowpipe has almost invariably been used by the chemist to decide the presence of these elements. While recognising the delicacy of the blowpipe methods for the detection of copper, cadmium, and bismuth, and the blowpipe as a most useful auxiliary in qualitative

work, I think the chemists will bear me out in the statement that the *test-tube*, and not *charcoal*, is the proper place for the detection of substances in a qualitative laboratory, and that the blowpipe methods should only be used as a confirmatory test. In order to illustrate this point I will state that, were entire reliance placed in the "bismuth flux" for the detection of bismuth, errors might arise; for example, mercury and antimony—both members of the H_2S group—give, under certain conditions, a red coat with the "bismuth flux" (4 parts S + 1 part KI).

By taking powdered stibnite (Sb_2S_3) and mixing it with 50 to 60 per cent sulphur, I succeeded several times in obtaining a very fine red coat, closely resembling the bismuth coat.

The objections to my scheme, so far as I have been able to find out, are, that students do not seem to think there is much difference between "gently warm," as I term it in the scheme, and to *boil hard* for about half-an-hour, thus causing a decomposition of the cyanogen compound and a deep blue colour. The second objection is the evolution of cyanogen and hydrocyanic acid.

Although I have not applied this method in quantitative separations of copper, cadmium, and bismuth, yet I see no reason why it should not be a good one, especially for cadmium and bismuth.

The excellent method of precipitation of copper by use of the battery seems to leave nothing to be desired in this direction.

Fresenius gives four methods in which bismuth may be weighed, placing the teroxide first on the list. He says the method gives accurate results, though generally a trifle too low, owing to the circumstance that bismuth carbonate is not absolutely insoluble in ammonium carbonate.

He also adds, "Were you to attempt to precipitate bismuth by means of ammonium carbonate from solutions containing sulphuric acid or hydrochloric acid, you would obtain incorrect results." Every author I have consulted says $\text{Bi}_2(\text{HO})_6$ is insoluble in KCy : it seems, therefore, highly probable that the decomposition of bismuth ferricyanide by KCy into $\text{Bi}_2(\text{HO})_6$ may be used as a quantitative method for the estimation of this metal. Furthermore, the presence of both hydrochloric acid and sulphuric acid does not seem to interfere with the complete separation of the hydroxide.

I have quite recently noticed that if an excess of potassium cyanide is not added, a ferrocyanide of copper separates on standing some time: whether this is a proto or diferrocyanide I am unable to say. I have also noticed that occasionally a few particles of a dark-looking compound separate, when solid potassium cyanide is used to dissolve the ferricyanides of copper and cadmium. The formation of this compound occurs immediately around the solid potassium cyanide, but seems to disappear by shaking or gently warming.

In regard to cadmium, Fresenius says it is weighed either as an oxide or a sulphide, giving the preference to the oxide. Yet he states that all compounds of cadmium, without exception, may be weighed as a sulphide, and the results are accurate.

The method of precipitation by hydrosulphuric acid has several objections; for example, you must not have a strong acid solution, much HCl and HNO_3 interfering with the complete precipitation.

The cadmium sulphide is almost invariably contaminated with sulphur, which must be dissolved out with carbon disulphide, which the chemists will, I think, generally agree with me is more or less a troublesome and disagreeable operation; or the sulphide may be boiled with sodium sulphite.

Sulphur does not separate in a solution containing potassium cyanide, when a metal is precipitated by hydrosulphuric acid, or ammonium sulphide; therefore my mode of procedure would not have the objection stated above.

PROCEEDINGS OF SOCIETIES.

BRITISH PHARMACEUTICAL CONFERENCE.

MEETING OF EXECUTIVE COMMITTEE.

July 5th, 1876.

PRESENT:—Professor Redwood, President; Messrs. Frazer, Williams, Carteighe, and Schacht, Treasurer; Professor Attfeld, Honorary Secretary; and Mr. Davies, Assistant-Secretary.

Thirteen candidates were elected to membership.

The names of several members, whose subscriptions were more than two years in arrear, and to whom repeated written applications had been made by the secretaries, were removed from the lists.

Twenty-six subjects proposed for research were received and considered.

Professor ATTFIELD suggested that some competent member should be employed to revise and somewhat elaborate the "subjects for papers" named in the current list issued by the Conference. In the course of thirteen years the Conference had proposed some two hundred subjects for research, of which nearly one hundred had since been investigated, resulting papers forming about one-third of the three hundred papers which had been read at the twelve annual meetings of the Conference. The one hundred or so of subjects now on the list, especially the fifty or sixty which had been down for several years, required careful revision, information concerning any work already accomplished being added to each subject, and some hints given as to the direction which further investigation should take. Probably a few of the subjects might now be excluded from the list altogether.

The secretaries were ordered to give effect to the suggestion.

The EDITOR reported good progress in the preparation of the MS. of the "Year Book of Pharmacy" for 1876.

Professor ATTFIELD reported that since the previous meeting of the committee he had issued about 2500 copies of the current Year-Book.

NOTICES OF BOOKS.

Legal Chemistry: a Guide to the Detection of Poisons; Examination of Stains, &c., as applied to Chemical Jurisprudence. By A. NAQUET. Translated, with additions, by J. P. BATTERSHALL, Nat. Sc.D., with a Preface by C. F. CHANDLER, Ph.D. M.D., &c. New York: Van Nostrand.

THE title-page of this book shows a step in the right direction. We are glad to see such misleading and illogical terms as "legal medicine," "forensic medicine," and "medical jurisprudence" replaced by the more accurate expressions used by our authors. The plan of the work before us is extensive, almost too much so for its compass of 178 pp. In addition to toxicology we find instructions for the detection of adulterations in articles of food and medicine, for the examination of blood-stains, &c., on weapons, clothing, &c., the determination of the nature of hair, and of its original colour, the examination of writings, of sympathetic inks, of suspected coins and alloys, and of human remains in the ashes of a fire-place. The section on alimentary and pharmaceutical substances may be pronounced thoroughly unsatisfactory. It embraces merely flour and bread, olive, colza, hemp-seed, and linseed oils, milk, wine, vinegar, and sulphate of quinine. The remarks on milk are evidently based upon old and erroneous analyses, since M. Naquet states that "good milk leaves upon evaporation 7.5 to 9.5 per cent of solid matter." We have heard a complaint that even the

standard of the Society of Public Analysts (11.5 per cent) has proved an encouragement to fraud, since milks are now carefully let down to this point. The lactometer, the lactoscope, and Marchand's instrument have now merely a historical interest, and it is surprising that they should be noticed in a practical manual. The directions for the examination of bread are little better. An analyst who should undertake the detection of alum by the method indicated in the text would be equally successful in its presence or in its absence. The reader is not even cautioned against the very possible presence of alumina and silica in his caustic alkali. The translator, to do him justice, adds a foot note, in which some of the shortcomings of the author are supplemented.

Under wine, we are told that the "most common adulteration is the addition of water!" With us, at least, the most common adulteration is the addition of extraneous alcohol, generally rich in amylic compounds. On the detection of this fraud and on "plastering" nothing is said. Why coffee, chocolate, tea, sweetmeats, &c., should be left out of sight does not appear.

The section on the recognition and discrimination of blood-stains is more in harmony with modern requirements. The author, however, observes:—"In the present state of science it is impossible to discriminate chemically between human and animal blood. M. Barruel, it is true, is able not only to accomplish this, but also to distinguish the blood of the various species of animals by its odour. But this test has a somewhat hypothetical value for scientific purposes."

We have all due respect for the nose as a preliminary instrument of qualitative research. Nor do we question that the flesh and the blood of different species, or at least groups of animals, may have a distinct specific odour. But remembering that the sense of smell varies exceedingly in delicacy, and that the whole amount of blood involved in such investigations is often very small, we think this test utterly inadmissible.

Nor can we speak with any favour of the instructions for the detection of human remains in the ashes of a fire-place. The author, indeed, practically admits their worthlessness when he says—"These indications, however, are reliable only when the certainty exists that the bones of animals have not been consumed in the same fire-place." How often is this certainty so absolute that a judicious chemist could presume to infer the presence of human remains from the occurrence of nitrogenous matter and phosphate of lime? The author justly points out the fallacious character of another supposed indication:—"It has been stated that the disengagement of sulphuretted hydrogen upon treating the ashes with sulphuric acid is an indication that the combustion of a human body has occurred (!) This reaction is, however, valueless, inasmuch as coal and certain vegetable ashes likewise evolve the same gas when subjected to the same treatment." We cannot help wishing to know what chemist can first have made so absurd a suggestion.

The section on the chemical examination of written documents supposed to have been tampered with is very interesting. The following passage exposes an ingenious fraud, against which the public should be put on their guard:—"The expert may possibly be called upon to give evidence as to the existence of a 'trompe l'œil,' as was the case in the trial of M. de Preigne, which took place at Montpellier in 1852. A 'trompe l'œil' consists of two sheets of paper glued together at the edges, but having the upper sheet shorter than the other, which, therefore, extends below it. This species of fraud is executed by writing unimportant matter on the upper sheet and then obtaining the desired signature, care being taken that it is written on the portion of the paper projecting below. The signature having been procured it is only necessary to detach the two sheets in order to have a blank paper containing the signature, over which whatever is desired can be inserted. The expert upon placing

pieces of moistened paper upon the suspected document noticed that they adhered to certain points, and that these formed a border around the paper, but passing *above* the signature."

We think that without great nicety of manipulation on the part of those carrying out this fraud the signator might easily notice the greater thickness of the body of the document as compared with the part where he is requested to sign.

One of the most valuable features of the work is an appendix, added by the translator, containing the bibliography of toxicology and its kindred branches of analytical chemistry. Not only independent works are here given, but all memoirs and papers in the leading scientific journals and in the transactions of learned societies, the whole forming a most useful index.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAS. BRAITHWAITE, M.D. Vol. lxxiii. January to June, 1876. London: Simpkin and Marshall.

THIS half-yearly issue, though replete with matter interesting to the medical practitioner, contains nothing of importance to the chemist. We find chloride of lead recommended as a deodoriser and disinfectant, and pronounced "the most powerful and economical agent for eliminating sulphide of hydrogen from the atmosphere, as well as from all organic matter in a state of decomposition or putridity."

Remarks on the Purification of Water and other Things. By LEWIS THOMPSON, M.R.C.S. Newcastle-upon-Tyne: Daily Journal Office.

FOR the purification of water the author recommends aluminite, the tribasic sulphate of alumina, or the same compound artificially prepared. He is, however, no believer in the "disease producing matters in water," and considers that the "proofs and evidences have wholly failed to establish any connection between the water and any disease whatever." There is no outcry made about purifying the air, because there is nothing to be got out of it. "It won't pay, and consequently it cannot be 'sanitarised.'"

We commend the following passage to the attention of all who pay, or are intending to pay, millions for having their sewage carried out to sea, and poured, as they fondly think, into deep water:—"There is a very interesting and even amusing circumstance connected with the waste of fertilising matters by the barbarous system called sewerage, and this circumstance admits of a happy illustration in the case of the existing metropolitan waste. We will now examine what must of necessity happen when the London sewage is sent from the mouth of the Thames. That sewage is lighter than sea-water, and consequently floats upon and does not mix with it, a fact very well known to the captains of our ships, who, though perhaps prevented by fog from seeing the land, know well when they are approaching the mouth of a river by the change in the colour of the water. The sewage, therefore, floats on the surface of the sea, and the most valuable portions of the sewage, which are also the most offensive, are not destroyed or got rid of in the way expected by the sewage scheme projectors, but find their way to the nearest shore, where they serve as food for animals. And what are the names of those animals? The two most numerous are the mussel and the oyster; the very animals which are collected by man and sent up to London as food for the inhabitants, thus showing that an

Even handed justice
Returns the ingredients of our poisoned chalice
To our own lips.

Much of this, quaintly and humorously as it is put, is only too true.

CORRESPONDENCE.

REACTION OF CHROMIC ACID WITH HYDRIC PEROXIDE.

To the Editor of the Chemical News.

SIR, I think that the result of a few observations on the action of hydric peroxide upon chromic acid may not prove uninteresting, and may possibly be useful in the course of a qualitative analysis. It has been before observed that hydric peroxide, when poured into a solution of chromic acid, produces a considerable change in the liquid. If, however, the liquid be first treated with a small quantity of ether, and after the addition of the hydric peroxide it be well agitated, a blue colour will be apparent in the ethereal portion of the solution. This reaction I have been led to use as a test thus. To the solution in a small test-tube I add, first, a quantity of ether sufficient to form a layer of from 3 to 4 millimetres in thickness. I then add a few drops of a solution of hydric peroxide, and agitate the whole together by inversion. If no blue colour is then apparent in the ethereal solution I add a few drops of strong hydric nitrate and a few more drops of hydric peroxide, and re-agitate the whole, when, if a chromate be present, a blue colour will develop itself in the ethereal layer. I have thus been enabled to detect the presence of chromic acid in a solution containing only $\frac{1}{1000}$ of its weight of potassic anhydro-chromate, corresponding to about $\frac{1}{1000}$ of chromic acid. As far as I have seen, this test is unaffected by the presence of nickel, cobalt, iron, manganese, aluminium, and other metals likely to occur in connection with chromium. It is, however, affected by the presence of hydric acetate, which causes the ether to dissolve in the aqueous solution, thereby rendering the blue colour very much less distinct. It is also necessary for the success of the test that there should be no free alkalis present, as they completely discharge the blue colour from the ethereal solution.—I am, &c.,

R. H. C. NEVILLE.

Chemical Laboratory,
Catholic University College, Wright's Lane,
Kensington.

DETERMINATION OF MANGANIC OXIDE.

To the Editor of the Chemical News.

SIR,—In reply to Mr. Allen's query in the *CHEMICAL NEWS* (vol. xxiv., p. 8), that gentleman will find the information he requires in any standard work on analytical chemistry—for instance, in H. Rose, vol. ii., p. 110 (French edition). But to save him the trouble of referring to any work, I may state that I discovered the manganic oxide in a very simple manner; namely, by determining in the first place the total quantity of oxygen, and in the next the total quantity of manganese. These two data are quite sufficient for the purpose. I think Mr. Allen might hesitate before he accuses chemists of counting oxygen twice over, especially when demanding advice upon so very simple a subject.—I am, &c.,

T. L. PHIPSON, Ph.D.

London, July 9, 1876.

INNS OF COURT PUMPS.

To the Editor of the Chemical News.

SIR,—You have propably observed in the *Daily News* of the 27th ult., a statement by Mr. W. Foster that New River water contained, "a short time ago," 0.004 gr. of ammonia per gallon, or, to express this in more convenient language, 0.0057 part per 100,000. I have recently made a number of analyses of New River water

and found it remarkably free from ammonia, containing even less than 0.001 part per 100,000. Referring also to the Registrar General's Reports of the present year, as far as I have them at the present moment before me, I find that New River water was free from ammonia in January, February, and April, containing in March only 0.001 part per 100,000. As the figure stated by Mr. Foster would convey to any one at all acquainted with London water the notion of a most alarming deterioration of the New River water, you will I hope excuse my troubling you with these lines.

Mr. Foster's statement that nitrates are among the characteristic constituents of sewage is evidently a slip of the pen, the reverse being the case.—I am, &c.,

GUSTAV BISCHOP.

Analytical Laboratory, 4, Hart Street,
Bloomsbury, London, July 8, 1876.

DR. J. W. HEARDER, F.C.S.

To the Editor of the Chemical News.

SIR,—May I ask why Mr. R. Meldola should have selected Mr. Hearder in particular as having degraded the Chemical Society by use of the F.C.S. after his name in an advertising or trade pamphlet.

There are two trade advertisements in your impression of this week containing these initials, yet I think it would be very hard to charge Mr. J. J. Griffin (one of the advertisers) with trumpeting the F.C.S. for trade purposes; it would be useless to do so, for the high character and scientific attainments of that gentleman are too well known. Mr., or more correctly speaking, Dr. Hearder is well known in the West of England as a man of great ability, and especially is he respected and his talents recognised by the inhabitants of Plymouth, where he has laboured hard for the progress of science, and the number of his pupils that have obtained honours in chemistry and experimental physics at the public examinations will speak for itself.

Dr. Hearder has been blind for many years, and anyone who has attended his lectures, carried out, as they must have been, under great difficulties, will agree that instead of bringing discredit on the Chemical Society he has been an honour to it.—I am, &c.,

F.C.S.

FORMATION OF OZONE BY THE CONTACT OF PLANTS WITH PEROXIDE OF HYDROGEN.

To the Editor of the Chemical News.

SIR,—Under the above heading, Mr. S. Cohné, in the CHEMICAL NEWS (vol. xxiv., p. 4) describes a few simple experiments, which, according to his interpretation, demonstrate that plants, by contact with peroxide of hydrogen, develop ozone. But the evidence he adduces is not sufficient to my mind to justify his deduction.

The results he obtained are as readily explicable on the view that the oxygen generated carries up with it a thin film or cloud of the aqueous solution containing peroxide of hydrogen, which latter body acts upon the potassic iodide (which was the reagent he employed as a test) with the same result as ozone. Inasmuch, therefore, that the test Mr. S. Cohné employed is one as readily susceptible to the influence of peroxide of hydrogen as to that of ozone, it is premature to write of the formation of ozone in this way.

It is in all probability a simple decomposition of peroxide of hydrogen into water and nascent oxygen. I have on several occasions conducted such experiments, and have further thought that the decomposing influence resided in the fibrin of the plant, an idea which derives some support from the fact which Mr. S. Cohné points

out, that a stem is more active where it has been cut through.

Animal fibrin is known to have this character in a high degree, and, indeed, it serves as one of the best tests for peroxide of hydrogen, while the latter serves a reciprocal purpose for fibrin. All facts regarding the various states of oxygen are of interest, because it is probable that oxygen may exist in several other forms to those with which we are at present acquainted.

Thus Odling has (CHEMICAL NEWS, vol. xxvi., p. 296) suggested the existence of a variety of oxygen, "the weight of any given volume of which, like that of a given volume of phosphorus vapour, shall furnish the weight of the element contained in four such volumes of its several simplest compounds;" and of yet another variety of oxygen, "the weight of any given volume of which, like that of any given volume of mercury vapour, shall furnish but the weight of the element contained in the same volume of its several simplest compounds."

Schönbein viewed every slow oxidation as attended by the formation of ozone, and taking the use of this word to imply, not the definite body bearing that name, but a state of activity of oxygen, this appears to be true. Moreover, I have noticed that peroxides, such as those of lead and manganese, variously prepared and of accepted purity, when heated in vacuo tube, give oxygen which has the power of liberating iodine from potassic iodide. But not enough is known of these matters to admit of an acceptable interpretation.—I am, &c.,

CHARLES T. KINOZETT.

Pathological Laboratory, 68, Earl's Court Road,
Kensington, W.

SALARIES OF PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—From the subjoined advertisement which I extract from the *Dublin General Advertiser*, it would appear that some of the Irish Grand Juries have peculiar views in regard to the importance of recent sanitary legislation and the status of chemists.

COUNTY OF LOUTH.

PUBLIC ANALYST.—The Grand Jury of this county will, at the ensuing Summer Assizes, receive Applications, and appoint a fit and proper person to fill the office of Public Analyst for said county, at a salary not exceeding Ten Pounds per annum, as arranged by the county at large Presentment Sessions.

T. F. FILGATE, Secretary to Grand Jury.

County Court House, Dundalk,
June 23, 1876.

None of the gentlemen who have arranged this salary would consider two pounds ten shillings per quarter sufficient wages for a stable boy. It is to be hoped for the honour of the chemical profession that the number of applications for the vacant post may be limited.—I am, &c.,

July 10, 1876.

PUBLIC ANALYST.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 24, June 12, 1876.

Experimental Criticism on Glycæmia: Physico-Chemical and Physiological Conditions to be Observed for the Detection of Sugar in the Blood.—M. C. Bernard.—Not adapted for abstraction.

Absorption of Free and Pure Nitrogen and Hydrogen by Organic Matters.—M. Berthelot.—The author describes his experiments and the apparatus employed.

Formation and Decomposition of Binary Compounds by the Electric Effluve.—M. Berthelot.—The action of the effluve, like that of the spark, tends to resolve compound gases into their constituents with the production of phenomena of equilibrium due to the inverse tendency to re-combination.

Electric Transmissions through the Soil.—M. Th. du Moncel.—Not capable of useful abstraction.

Certain New Experiments made with the Radiometer of Mr. Crookes.—M. A. Ledieu.—The radiometer was found to continue revolving when submitted exclusively to a pencil of luminous rays falling parallel to its axis. The author, however, does not draw the conclusion to which a superficial and systematic examination of this result might seem to lead. The experiment performed by M. Salleron at the suggestion of the author condemns decidedly the doctrine of emission as an explanation of the movement of the radiometer.

Law of Dulong and Petit.—M. Terrell.—The product of the specific heat by the chemical equivalent is a constant, on condition that all the bodies are taken of the same gaseous volume and before all condensation. The specific heat of elementary bodies taken at the same volume in the gaseous state is inversely as their chemical equivalents. The specific heat of compound bodies, under the same condition, is inversely proportional to their chemical equivalents, and proportional to the condensation which the gaseous volumes of the simple bodies constituting them have undergone on combining. Simple or compound bodies which have lost the gaseous state have a specific heat double that which they possessed when in the state of gas.

Phenomena of Electric Oscillation.—M. L. Mouton.—Not adapted for abstraction.

On Propylenic Chlorhydrines and on the Law of Addition of Hypochlorous Acid.—M. L. Henry.—A purely hypothetical paper, in which the author combats the views of M. Markownikoff.

Elementary Analysis of Electrolytic Aniline-Black.—M. Fr. Goppelsröder.—The black analysed had been obtained by passing the galvanic current through an aqueous solution of pure hydrochlorate of aniline. The deposit formed at the positive electrode was purified by successive treatments with water, alcohol, ether, benzine, and again with alcohol. After this purification the substance was then dried at 110°, and appeared as a velvet-black powder. The mean result of 11 analyses was:—

Carbon	71.366.
Hydrogen	5.241
Nitrogen	15.327
Chlorine	8.941

100.875

This composition leads to the formula $C_{24}H_{21}N_4Cl$. If boiled with a dilute solution of caustic potassa this substance loses all its chlorine and is changed into a black body of a crystalline appearance with a metallic reflection. The velvet-black powder is the mono-hydrochlorate of a base tetramine, $C_{24}H_{20}N_4$, which forms mono-acid salts very readily. The black obtained by the electrolysis of hydrochlorate of aniline has the formula $C_{24}H_{20}N_4 + HCl$, and that from the sulphate must therefore be, $2(C_{24}H_{20}N_4 + H_2SO_4)$. If the electrolytic black is heated vapours of aniline are given off and a violet colouring matter sublimes. If aniline-black is treated in sealed tubes at not less than 190° (up to 150° there is no action) with aniline, methyl-diphenylamine, pseudo-toluidin, methyl-aniline, and nitro-benzin; these substances attack the black and become coloured, aniline taking the violet, methyl-diphenylamine a brown, pseudo-toluidin a violet-

brown, methyl-aniline a red-brown, and nitro-benzin a brown-red. Under analogous treatment alcohol takes a violet colour, the liquid giving the following reactions:—It is decolourised by hydrochloric and sulphuric acids, but the colour returns after neutralisation with ammonia. Chlorine water and sulphurous acid destroy it; a small quantity of caustic potassa turns it blue, whilst an excess of the reagent renders it a violet-red. Nitric acid gives it a brown-violet shade, and acetic acid a brown, which returns to violet on saturation with caustic potassa. In like conditions the black is also attacked by iodide of ethyl, but the changes occasioned require further examination.

On Anthraflavon and an Accessory Product of the Manufacture of Artificial Alizarin.—M. A. Rosenstiehl.—The author showed in 1874 (*Comptes Rendus*, lxxix., p. 764) that the anthraflavon of Barth and Sennhofer if melted with caustic potassa gives simultaneous rise to two colouring matters, one of which, soluble in benzine and in alum water, dyes mordanted tissues shades bordering upon those of alizarin, whilst the other, insoluble in the same liquids, approaches purpurin; the shades obtained in dyeing are, in brightness and solidity, comparable to those of madder. The former of these colours is produced in such small quantities that its examination has not been hitherto possible. The latter is more plentiful, and is an isomer of purpurin approaching the isopurpurin or anthrapurpurin of Perkin. Anthraflavon itself is a mixture of two isomers of alizarin distinguished by their behaviour with bases. The one forms a soda salt very soluble in water; it dissolves in baryta water, which it colours a deep orange yellow, combines with gelatinous alumina to form an orange lake, and if melted with caustic potash between 135° and 150° it forms the isomer of purpurin just mentioned. The other yields a soda salt sparingly soluble, and readily crystallisable; it is insoluble in cold baryta water, does not combine with gelatinous alumina, and if melted with potassa at the same temperature it does not give rise to a colouring matter; a little only is formed at a higher temperature, with the destruction of a large proportion of the substance. This second body can be obtained in the form of fine silky needles, which in bulk present the yellow colour of chromate of lead, and recalls the aspect of chrysophenic acid. This body is identical with an accessory product of the manufacture of artificial alizarin from the works of Przibram and Co., of Praz.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 30, June, 1876.

Deposits of Fossil Phosphate of Lime in the Departments of Ardennes and La Meuse.—An account of the phosphatic strata, and of the mining operations carried on. The phosphoric acid in the nodules varies from 16.3 to 31 per cent, the oxide of iron ranging from 4.30 to 15.65 per cent. The amount of alumina present is not specially determined but included under the somewhat vague heading "sand and clay."

Reimann's Farber Zeitung,
No. 22, 1876.

J. Wagner proposes to protect alizarin steam reds from the injurious action of the steel "doctors" by adding 20 grms. sulphocyanide of potassium to each litre of colour. Sulphocyanide of ammonia is not effective.

No. 23, 1876.

Häitra is the name of a vegetable substance recently introduced into commerce for thickening colours and giving body to textile wares. To prepare it for use, it is first washed, and then boiled at 130° in a closed vessel with 60 parts of water.

MISCELLANEOUS.

American Chemical Society.—At a meeting of American chemists, held in April last at the New York College of Pharmacy, it was resolved to form a society, to be called "The American Chemical Society," and at a subsequent meeting the following officers and committees were appointed:—*President*—John W. Draper. *Vice-Presidents*—J. Lawrence Smith, Frederick A. Genth, E. Hilgard, J. W. Mallet, Charles F. Chandler, Henry Morton. *Corresponding Secretary*—George F. Barker. *Recording Secretary*—Isidor Walz. *Treasurer*—W. M. Habirshaw. *Librarian*—P. Casamajor. *Curators*—Edward Sherer, W. H. Nichols, Frederick Hoffmann. *Committees on Papers and Publications*—Albert R. Leeds, Herrmann Endemann, Elwyn Waller. *Committee on Nominations*—E. P. Eastwick, M. Alsberg, S. St. John, Charles Fröbel, Chas. M. Stillwell.

Experiments with Frozen Dynamite.—Some interesting experiments were recently made at the works of the British Dynamite Company at Stevenston, Ayrshire, with the view of proving that dynamite in a frozen state is as safe to handle and to transport as in an unfrozen state. Professors James Thomson and Bottomley, of the University of Glasgow, were present. In the first experiment several cartridges in a frozen state, and in some parts beginning to thaw, were thrown one by one from the hand, with great force, against an iron plate without explosion. In the second experiment, a block of iron, about 400 lbs. weight, was allowed to fall from a height of about 20 feet on a light wooden box containing 20 lbs. of dynamite cartridges in a frozen state, and with slight signs of incipient thawing in spots more exposed to the warmth of the air. The box was smashed, and the cartridges were crushed flat and pounded together, but there was no explosion. The crushed cartridges were next made up into two heaps to be exploded. The ordinary detonator shatters but does not explode the frozen dynamite. The explosion was therefore effected by inserting in each heap a small unfrozen cartridge, with the ordinary detonator inserted into it, and then firing this off by a Beckford fuse. The two heaps were exploded successively, and it is worthy of remark that the explosion of the first, though very violent, did not set the other off.

British Association for the Advancement of Science.—The following are the officers of the forty-sixth annual meeting of the British Association which will commence at Glasgow on Wednesday, September 6th, 1876:—*President designate*—Prof. Thos. Andrews, M.D., LL.D., F.R.S., Hon. F.R.S.E., in the place of Sir Robert Christison, Bart., who has resigned the Presidency in consequence of ill health. *Vice-Presidents elect*—His Grace the Duke of Argyll, K.T., F.R.S., &c.; the Lord Provost of Glasgow; Sir William Stirling Maxwell, Bart., M.A., M.P.; Prof. Sir William Thomson, D.C.L., F.R.S., &c.; Prof. Allen Thomson, M.D., LL.D., F.R.S., &c.; Prof. A. C. Ramsay, LL.D., F.R.S., &c. *General Secretaries*—Capt. Douglas Galton, C.B., D.C.L., F.R.S., &c.; Dr. Michael Foster, F.R.S. *Assistant General Secretary*—George Griffith, M.A., F.C.S., &c. *General Treasurer*—Prof. A. W. Williamson, Ph.D., F.R.S. *Local Secretaries*—Dr. W. G. Blackie, F.R.G.S.; James Grahame; J. D. Marwick. *Local Treasurers*—Dr. Fergus; A. S. McClelland. The President of Section A (Mathematical and Physical Science) will be Prof. Sir Wm. Thomson, D.C.L., F.R.S.; of Section B (Chemical Science), Mr. W. H. Perkin, F.R.S. On Thursday evening, Sept. 7th, at 8 p.m., there will be a *Soirée*; on Friday evening, Sept. 8th, at 8.30 p.m., a Discourse; on Monday evening, Sept. 11th, at 8.30 p.m., a Discourse by Prof. Sir C. Wyville Thomson, F.R.S.; on Tuesday evening, Sept. 12th, at 8 p.m., a *Soirée*; on Wednesday, Sept. 13th, the concluding general meeting will be held at 2.30 p.m.

TO CORRESPONDENTS.

H. Cant.—Hopkin and Williams, or from Dr. Theodor Schuchardt Chemische Fabrik, Gorlitz.

THE
QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c.

Now ready No. LI., July, 1876, price 5s.

CONTENTS.

- I. On the Geological Age of the Deposits containing Flint Implements, at Hoxne, in Suffolk, and the Relation that Palæolithic Man Bore to the Glacial Period. By Thomas Belt, F.G.S.
- II. A Scheme of Water Supply for Villages, Hamlets, and Country Parishes of the Central and Eastern Counties. By Prof. Hull M.A., F.R.S., F.G.S.
- III. Vivisection.
- IV. Infusorial Earth and its Uses.
- V. The Nizam Diamond—The Diamond in India. By Captain Richard P. Burton.
- VI. Certain Phases of Bird Life. By Charles C. Abbott, M.D.
- VII. The Loan Exhibition of Scientific Apparatus at South Kensington.

Notices of Scientific Works, Progress of the Various Sciences, &c.

London: 3, Horse-Shoe Court, Ludgate Hill, E.C.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 869.

ON REPULSION RESULTING FROM RADIATION. INFLUENCE OF THE RESIDUAL GAS.*

(PRELIMINARY NOTICE.)

By WILLIAM CROOKES, F.R.S., &c.

I HAVE recently been engaged in experiments which are likely to throw much light on some obscure points in the theory of the repulsion resulting from radiation. In these I have been materially assisted by Prof. Stokes, both in original suggestions and in the mathematical formulæ necessary for the reduction of the results. Being prevented by other work from completing the experiments sufficiently to bring them before the Royal Society prior to the close of the session, I have thought that it might be of interest were I to publish a short abstract of the principal results I have obtained, reserving the details until they are ready to be brought forward in a more complete form.

In the early days of this research, when it was found that no movement took place until the vacuum was so good as to be almost beyond the powers of an ordinary air-pump to produce, and that as the vacuum got more and more nearly absolute so the force increased in power, it was justifiable to assume that the action would still take place when the minute trace of residual gas which theoretical reasoning proved to be present was removed. The first and most obvious explanation therefore was that the repulsive force was directly due to radiation. Further consideration, however, showed that the very best vacuum which I had succeeded in producing might contain enough matter to offer considerable resistance to motion. I have already pointed out that in some experiments, where the rarefaction was pushed to a very high point, the torsion beam appeared to be swinging in a viscous fluid (194), and this at once led me to think that the repulsion caused by radiation was indirectly due to a difference of thermometric heat between the black and white surfaces of the moving body (195), and that it might be due to a secondary action on the residual gas.

On April 5, 1876, I exhibited, at the *Soirée* of the Royal Society, an instrument which proved the presence of residual gas in a radiometer which had been exhausted to a very high point of sensitiveness. A small piece of pith was suspended to one end of a cocoon fibre, the other end being attached to a fragment of steel. An external magnet held the steel to the inner side of the glass globe, the pith then hanging down like a pendulum, about a millimetre from the rotating vanes of the radiometer. By placing a candle at different distances off, any desired velocity, up to several hundreds per minute, could be imparted to the fly of the radiometer. Scarcely any movement of the pendulum was produced when the rotation was very rapid; but on removing the candle, and letting the rotation die out, at one particular velocity the pendulum set up a considerable movement. Prof. Stokes suggested (and, in fact, tried the experiment at the time) that the distance of the candle should be so adjusted that the permanent rate of rotation should be the critical one for synchronism corresponding to the rate at which one arm of the fly passed for each complete oscillation. In this way the pendulum was kept for some time swinging with regularity through a large arc.

This instrument proved that, at a rarefaction so high that the residual gas was a non-conductor of an induction current, there was enough matter present to produce motion, and therefore to offer resistance to motion. That this residual gas was something more than an accidental accompaniment of the phenomena was rendered probable by the observations of Dr. Schuster, as well as by my own experiments on the movement of the floating glass case of a radiometer when the arms are fixed by a magnet.*

My first endeavour was to get some experimental means of discriminating between the viscosity of the minute quantity of residual gas and the other retarding forces, such as the friction of the needle-point on the glass cup when working with a radiometer, or the torsion of the glass fibre when a torsion-apparatus was used. A glass bulb is blown on the end of a glass tube, to the upper part of which a glass stopper is accurately fitted by grinding. To the lower part of the stopper a fine glass fibre is cemented, and to the end of this is attached a thin oblong plate of pith, which hangs suspended in the centre of the globe: a mirror is attached to the pith bar, which enables its movement to be observed on a graduated scale. The stopper is well lubricated with the burnt india-rubber which I have already found so useful in similar cases (207). The instrument is held upright by clamps, and is connected to the pump by a long spiral tube. The stopper is fixed rigidly in respect to space, and an arrangement is made by which the bulb can be rotated through a small angle. The pith plate, with mirror, being suspended from the stopper, the rotation of the bulb can only cause a motion of the pith through the intervention of the enclosed air. Were there no viscosity of the air, the pith would not move; but if there be viscosity, the pith will turn in the same direction as the bulb, though not to the same extent, and, after stopping the vessel, will oscillate backwards and forwards in decreasing arcs, presently setting in its old position relatively to space.

It was suggested by Prof. Stokes that it would be desirable to register not merely the amplitude of the first swing, but the readings of the first five swings or so. This would afford a good value of the logarithmic decrement (the decrement per swing of the logarithm of the amplitude of the arcs), which is the constant most desirable to know. The logarithmic decrement will involve the viscosity of the glass fibre, but glass is so nearly perfectly elastic, and the fibre so very thin, that this will be practically insensible.

According to Prof. Clerk Maxwell the viscosity of a gas should be independent of its density; and the experiments with this apparatus have shown that this is practically correct, as the logarithmic decrement of the arc of the oscillation (a constant which may be taken as defining the viscosity of the gas) only slightly diminishes up to as high an exhaustion as I can conveniently attain—higher, indeed, than is necessary to produce repulsion by radiation.

I next endeavoured to measure, simultaneously with the logarithmic decrement of the arc of oscillation, the repulsive force produced by a candle at high degrees of exhaustion. The motion produced by the rotation of the bulb alone has the advantage of exhibiting palpably to the eye that there is a viscosity between the suspended body and the vessel; but once having ascertained that, and admitting that the logarithmic decrement of the arc of oscillation (when no candle is shining on the plate) is a measure of the viscosity, there is no further necessity to complicate the apparatus by having the ground and lubricated stopper. A movement of the whole vessel bodily through a small arc is equally effective for getting this logarithmic decrement; and the absence of the stopper enables me to have the whole apparatus sealed up in glass, and I can therefore experiment at higher rarefactions than would be possible when a lubricated stopper is present.

* A Paper read before the Royal Society, June 15, 1876.

* *Proc. Roy. Soc.*, March 30, 1876.

The apparatus, which is too complicated to describe without a drawing, has attached to it—*a*, a Sprengel pump; *b*, an arrangement for producing a chemical vacuum; *c*, a lamp with scale, on which to observe the luminous index reflected from the mirror; *d*, a standard candle at a fixed distance; and *e*, a small vacuum-tube, with the internal ends of the platinum wires close together. I can therefore take observations of—

1. The logarithmic decrement of the arc of oscillation when under no influence of radiation.
2. The logarithmic decrement of the arc of oscillation when a candle shines on one end of the blackened bar.
3. The appearance of the induction-spark between the platinum wires.

1 measures the viscosity; 2 enables me to calculate the force of radiation of the candle; and 3 enables me to form an idea of the progress of the vacuum, according as the interior of the tube becomes uniformly luminous, striated, luminous at the poles only, or black and non-conducting.

The apparatus is also arranged so that I can try similar experiments with any vapour or gas.

The following are some of the most important results which this apparatus has as yet yielded:—

Up to an exhaustion at which the gauge and barometer are sensibly level there is not much variation in the viscosity of the internal gas (dry atmospheric air). Upon now continuing to exhaust, the force of radiation commences to be apparent, the viscosity remaining about the same. The viscosity next commences to diminish, the force of radiation increasing. After long-continued exhaustion the force of radiation approaches a maximum, but the viscosity measured by the logarithmic decrement begins to fall off, the decrease being rather sudden after it has once commenced.

Lastly, some time after the logarithmic decrement has commenced to fall off, and when it is about one-fourth of what it was at the commencement, the force of radiation diminishes. At the highest exhaustion I have yet been able to work at, the logarithmic decrement is about one-twentieth of its original amount, and the force of repulsion has sunk to a little less than one-half of the maximum. The attenuation has now become so excessive that we are no longer at liberty to treat the number of gaseous molecules present in the apparatus as practically infinite; and, according to Prof. Clerk Maxwell's theory, the mean length of path of the molecules between their collisions is no longer very small compared with the dimensions of the apparatus.

The degree of exhaustion at which an induction-current will not pass is far below the extreme exhaustions at which the logarithmic decrement falls rapidly.

The force of radiation does not act suddenly, but takes an appreciable time to attain its maximum; thus proving, as Prof. Stokes has pointed out, that the force is not due to radiation directly, but indirectly.

In a radiometer exhausted to a very high degree of sensitiveness, the viscosity of the residual gas is almost as great as if it were at the atmospheric pressure.

With other gases than air the phenomena are different in degree, although similar in kind. Aqueous vapour, for instance, retarding the force of repulsion to a great extent, and carbonic acid acting in a similar though less degree.

The evidence afforded by the experiments of which this is a brief abstract is to my mind so strong as almost to amount to conviction that the repulsion resulting from radiation is due to an action of thermometric heat between the surface of the moving body and the case of the instrument, through the intervention of the residual gas. This explanation of its action is in accordance with recent speculations as to the ultimate constitution of matter, and the dynamical theory of gases.

ON THE ACTION OF CERTAIN KINDS OF FILTERS ON ORGANIC SUBSTANCES.

PART IV.

By J. ALFRED WANKLYN.

IN continuing my investigation I have experimented on a solution of strychnine. In 10 litres of London Thames water (West Middlesex Company), which yielded 0.05 m.grm. of albuminoid ammonia per litre, I dissolved 1.263 grms. of strychnine, using a little hydrochloric acid (about 5 c.c. of the strong acid) to facilitate the solution.

As will be seen, this solution contains 0.1263 grm. of strychnine per litre, or 8.841 grains per gallon. Such a solution is bitter to the taste. I drank 5 c.c. of it, and found it to be very bitter.

Submitted to the "ammonia process" the solution yielded 5.20 m.grms. of albuminoid ammonia per litre.

In making the experiment on the filtration of this solution I desired to ascertain whether or not the silicated carbon filter preserves its power, and accordingly employed the same filter which had already absorbed quinine and morphia in previous experiments. Already the filter had taken up about 0.7 grm. of acid sulphate of quinine and 1.3 grms. of hydrochlorate of morphia, and since taking up these alkaloids had not had very large quantities of water passed through it. The filter was very carefully drained of water, and then the 10 litres of the above-described solution of strychnine placed in it. The first 5 litres of filtrate were thrown away, and the remainder was collected.

Submitted to the ammonia process it yielded some free ammonia and 0.04 m.grm. of albuminoid ammonia per litre, which shows that the filtrate was devoid of strychnine.

I have sufficient confidence in the ammonia process to wager my life on the correctness of the results, and I drank 300 c.c. of the filtrate. It was not bitter, and I have not experienced any symptoms of poisoning with strychnine; and, as will be found on making the calculation, 300 c.c. of the unfiltered liquid contained about 40 m.grms. of strychnine, which is a poisonous dose.

ACTION OF SODIUM ON BENZOL.

I.

SOME observers have stated* that when benzol is heated or digested with sodium it is decomposed or acted upon, but the nature of the product is not stated.

Why potassium or sodium should act upon a comparatively inert substance like benzol is not, from theoretic grounds, very evident.

To prove whether sodium has any action on C_6H_6 within a moderate range of temperature the following experiments have been made:—

Very pure benzol was prepared, by agitating the ordinary benzol with strong oil of vitriol for some days, washing with potassic hydrate, and distilling from water; it was then dried with calcic chloride, and redistilled; after which it was further purified by several crystallisations, the crystals of benzol being pressed between (in a hand-screw press) each operation, to separate any uncrystallisable hydrocarbon which might remain.

This benzol boils constantly at 80.5° to 81° , and its vapour density and percentage composition, by combustion, agree very closely with the calculated numbers: 8 to 10 c.c. of this benzol, along with 1 to 1.5 grm. clean-cut sodium, was introduced into strong tubes (about 15 inches long), the benzol warmed so that its vapour expelled the air from the tubes, which were then sealed and heated in an oil-bath to $150^\circ C.$ for four hours, at the end

* "Watts's Dictionary" (Benzene).

of which time a tube was examined, but the sodium showed no further signs of action than fusion into globules. The remaining tubes were then heated to 200° to 250° C. for eighteen hours, when very little change was apparent, and the surfaces of the sodium having only a very slight brownish tint.

On opening the tubes under mercury, no—or only a very minute quantity of—gas was found to have been produced, the mercury almost entirely filling the remainder of the tube not occupied by the liquid benzol.

The benzol distilled entirely away between 80° to 81° without leaving any residue.

Potassium in the presence of finely-divided silver had no more effect than the sodium alone.

Zinc, or the copper-zinc couple, is also without action at temperatures up to 150° C.

It was found unsafe to continue the action of sodium at temperatures much higher than 250° C., several violent explosions taking place, probably owing to the action of the fused sodium on the glass.

II.

If clean pieces of sodium or potassium be warmed under benzol in which phosphorus is dissolved, or pieces of sodium and phosphorus heated gently together under benzol, the surface of the metal becomes covered with a brilliant red film of amorphous phosphorus, which adheres very closely and prevents further action.

The same action takes place in the cold, the film appearing at first yellow. It forms very rapidly on boiling, when the red substance on its first formation has the appearance of melting on the surface of the containing vessel.

No metallic phosphide is formed at temperatures under 100° C., and the benzol is not affected.

W. R. H.

Royal College of Chemistry,
South Kensington, July, 1876.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 5.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

Chlorine and Chloride of Lime.—By far the larger portion of the hydrochloric acid evolved in Leblanc's soda process is utilised in the preparation of chlorine as an intermediate product in the manufacture of chloride of lime. As is well known the native peroxide of manganese (pyrolusite) has long been employed for this purpose. As long as this mineral was to be found in sufficient quantity there was no occasion to seek out any substitute. By degrees the manganese mines became less productive, the samples in the market grew poorer in the effective ingredient, peroxide of manganese, and the prices became higher. Hence, on the one hand, experiments became necessary to re-convert the chloride of manganese—the residue from the production of chlorine—into peroxide, in order thus to reduce the outlay for manganese and to bring back a useless and troublesome residue into industrial circulation; on the other hand, attempts were made to produce chlorine without the intervention of manganese.

The first procedure for the regeneration of manganese from its residues which has met with a practical application is that of Dunlop; the chloride of manganese being

decomposed by carbonate of lime, and steam at a pressure of from 2 to 4 atmospheres, and the carbonate of manganese thus formed being heated to 300° to 400° C. This procedure was carried out in the colossal establishment of Messrs. Tennant, at Glasgow, but has not been generally adopted among manufacturers of chlorine. It requires costly plant without accomplishing the required object—a perfect regeneration of the manganic oxide. An improvement on this process, although not industrially available, was that of Clemm* who substituted carbonate of magnesia for chalk. From the magnesium chloride formed by the decomposition of the manganese chloride he liberated hydrochloric acid by means of superheated steam, whilst the magnesia simultaneously formed was again applicable for the precipitation of fresh quantities of manganese solutions. This method, therefore, provided for the regeneration of the chlorine united with the manganese, which in Dunlop's original process was lost in the almost useless form of chloride of calcium. A method of regenerating manganese, very advantageous under certain circumstances, has been devised by P. W. Hofmann, and has been successfully introduced in the works at Dieuze, and in certain German establishments. The inventor combines the regeneration of manganese in a successful manner with that of sulphur.† Hofmann precipitates the solution of manganese with the yellow polysulphides of calcium obtained by the lixiviation of vat-waste after prolonged exposure to the air. The manganese sulphide thus obtained, containing 57·5 per cent of sulphur, is burnt, a part of the sulphur being recovered as sulphurous acid and conducted into the chambers. The residue is heated with nitrate of soda (1 mol. to 1 atom of manganese in the residue), and thus converted into a higher oxide of manganese, which is then transferred to the chlorine stills as a manganese of 55 per cent. Oxides of nitrogen are evolved at the same time, which, with the aid of water and air, can be condensed as nitric acid. The peroxide thus obtained consumes, indeed, 2 to 3 per cent more hydrochloric acid than native manganese, but is much more readily soluble.

Passing over other attempts at the same object, we may mention, as a curiosity, one process which proves, at least, how intense has been the desire to regenerate manganese. Esquiron and Gouin make the ingenious proposal to revivify manganese residues for the preparation of chlorine by means of chloride of lime!

(To be continued.)

ON MEASURING AIR IN MINES.‡

By JOSEPH DICKINSON, F.G.S.,

H.M. Inspector of Mines.

ANEMOMETERS, or air-meters as they are often called, are now in common use for measuring the velocity of air-currents in mines. Forty years ago they were seldom seen. The methods then practised are described in the well known report prepared by Mr. James Mather, Honorary Secretary of the South Shields Committee appointed in the year 1839 to investigate accidents in mines. They were by the smoke of gunpowder or tobacco, and the regulated pace of a person by the flame of a candle. No mechanical appliance appears to have been in use. The report refers to an anemometer constructed by Mr. Thomas Elliot (a brother of the present baronet, Sir George) in 1835, when an overman of Fensher Colliery, which worked by "the air acting on four wands similar to a windmill, which met so strongly with the approval of the coal-owners that in that year, at their meeting at Newcastle-on-Tyne, they presented him with ten guineas for his invention, but they did not adopt it in one of their mines."

* Clemm, *Dingl. Pol. Journ.*, clxxiii., 128.

† Compare Dr. F. Tiemann's remarks on the utilisation of soda residues in a subsequent part of the present report.

‡ A Paper read before the Manchester Geological Society.

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

The first anemometers which appear to have come into general use in mines were those of M. Charles Combes, of Paris, and Mr. Benjamin Biram, of Wentworth, Yorkshire, both being similar in principle to Mr. Elliott's. M. Combes, in his valuable work, "*Traité de l'Exploitation des Mines*, 1844," refers to a description of his anemometer written by him in the *Annales des Mines*, by which it appears that his anemometer was introduced in 1837. Mr. Biram's anemometer, it seems by the patent specification, was sealed August 3, 1842, the scope of it being for registering the velocity of bodies propelled through water or wind and employment for paddle-wheels, stern-propellers, and other rotary engines. M. Combes's instruments seem to have been made by M. Newman, of Paris, and Mr. Biram's by Mr. Davis, of Derby.

Robinson's anemometer, consisting of four revolving hemispherical hollow cups fixed on four arms radiating from a centre (as commonly used on observatories), have as yet been but little used in mines. It appears by F. Pastorelli and Co.'s work on standard instruments, and by other authorities, that this anemometer was invented by Dr. Robinson, of Armagh, and that it was used in tidal and meteorological observations on the coast of Ireland in 1850. It is also stated that Dr. Robinson, after a series of carefully conducted experiments, found that these cups fixed upon a vertical axis travel at the rate of one-third of that of the wind, and that this law exists irrespectively of the size of the cups or the length of the arms.

Another combination of the windmill anemometer has recently come into use in mines. The arrangement is attributed to Dr. Parkes, F.R.S., for whom it is said to have been originally made by Mr. Lowndes, a working instrument maker in London. This instrument is sometimes known as the Casella or Casartelli anemometer.

All windmill anemometers, it will be understood, require timing, and also correction, in order to ascertain the true velocity of the air from the number of revolutions.

Anemometers, "a mere inspection of which would enable an officer to ascertain in an instant the exact velocity of the air, without the necessity of timing or correcting," have long been known, but the only one that I know of as being in use in mines, is the one devised by myself about twenty-five years ago, which is known as the Dickinson anemometer. By means of this the velocity of the air may be read off at a glance. It consists of a light, counterpoised, flat fan-plate, which is usually made of talc, and hung upon two fine bearings, so as to be easily moved by the air current. Alongside of the fan-plate there is a quadrant, graduated and figured—the figure up to which the fan-plate is blown being the velocity of the air, in feet, per minute. There is also a spirit-level for setting the instrument level. In using this instrument all that is requisite to ascertain the number of cubic feet of air passing per minute is to multiply the velocity indicated by the anemometer into the area in feet of the place where the observation is taken. These anemometers have been made only by Mr. Casartelli, of Manchester.

A modification of the Dickinson anemometer, which I have seen permanently fixed in the Bardsley Colliery, Ashton-under-Lyne, by Mr. George Wild, has the counterpoise made of a balance weight, which is worked by a chain over a pulley. For a fixture, like this, the chain and weight counterpoise appears to be an improvement, as the friction of the links of the chain over the pulley imparts steadiness to the fan-plate, and thus enables the average velocity to be better read in intermitting currents.

About the same time as the introduction of the Dickinson anemometer, Mr. John Phillips, of Cornwall, devised a similar instrument, except that, as I understand, it had no counterpoise.

M. Devillez has also introduced one on the same principle, but with a hollow cylindrical cup instead of the fan-plate.

Another, with a flat plate suspended by two rods, by

Dr. Prestell, is described by Messrs. Negretti and Zambra, of London, in their illustrated catalogue for 1873.

Mr. William Peace, of Wigan, also patented an anemometer about twenty years ago, the moving power being from the action of air on a block of wood hung in the downcast shaft, from which, by means of a wire or cord, motion is given to a finger on a dial-plate above ground.

The foregoing anemometers are apparently the principal ones which have as yet been proposed for or actually used in mines. A variety of others, however, some of ancient date, have been used for measuring the wind on the surface.

The first anemometer of which there appears to be any record is attributed to Dr. Croune, in 1667, which, it is said, did not answer the purpose intended. Better instruments seem to have been invented by other scientific men during the last century. The modes of action comprised the compression of a spiral spring, the elevation of a weight round a centre acting at the arm of a variable lever, a bag of air communicating with a glass tube, in the form of a lengthened U, being sometimes substituted for the spring. An anemometer by Leslie depended on the principle that the cooling power of a current of air is equal to its velocity. Another instrument depended upon the evaporation of water, the quantity evaporated being proportional to the velocity of the wind, varying, however, one would suppose, according to the dryness of the wind.

Wolfius's anemometer, as described by him in 1746, consisted of four sails similar to those of a windmill, but smaller, turning on an axis. On the axis is a perpetual screw, which turns a vertical cog-wheel round a second axis. To the second axis is attached a bar on which a weight is fixed, so that the sails cannot turn without moving round this bar in a vertical circle. When the wind acts upon the sails the bar rises, and this continues until the increased leverage of the weight furnishes a counterpoise to the moving force of the wind. It also appears to have acted by winding up a weight.

Regnier's anemometer indicated the pressure upon a dial-plate, the moving power being a flat wooden surface on which the air acted, pressing it into a box with springs and mechanism.

The anemometers of Dr. Whewell and Mr. Osler are described in Sir W. Snow Harris's report to the British Association, in 1841-44. That of Dr. Whewell was by means of a windmill fly, which worked an intermediate train of wheels and caused the varying pressure to be marked on a fixed cylinder. Mr. Osler's traced the direction of the wind and its pressure on a given area, which was moved by clock mechanism. An invention by the Rev. W. Foster is also described as ingenious.

Lind's anemometer, which is an inverted glass syphon in the form of a U, is described in the *Philosophical Transactions*, 1775. An improvement of this has been made by Sir W. Snow Harris, who, by reducing one of the limbs to the diameter of one-fourth of the tube which is open to the wind, and by making the first part of the scale horizontal, has greatly increased the delicacy of the instrument. He also put a plumb on it, and a light vane, to facilitate observation.

As a water-gauge or manometer, the inverted glass syphon, known as Lind's anemometer, is identical with what is now commonly used in mines for measuring the pressure of air. The water-gauge introduced a few years ago by Mr. John Daglish, formerly of Hetton Colliery, Durham, is on the same principle.

M. E. Péclét, in his valuable "*Traité de la Chaleur*, Paris, 1860," says, that in 1820, M. Kallisténius employed a mill with twelve wands to measure the force of the air, and he describes M. Combes's anemometer. He also refers to a novel one by M. Morin, somewhat the same as M. Combes's. Also to the apparatus by M. Van Hecke, by which the ventilation is registered. Likewise to other instruments; in one instance by means of the air acting upon the surface of a body attached to one end of an arm working over a centre, there being a pointer at the other

end of the arm which indicates the force on a dial; and in another instance by the air acting upon hollow cylindrical cups hung in the current, by which a finger is worked on a dial plate. He also describes various water-gauges, both for ordinary and for great precision, including, amongst the latter, one having one of the limbs inclined.

These are apparently the principal anemometers which have as yet been introduced, either above or below ground. It is possible, however, that others may have been used, and even that some of them may have been invented by other persons than those whose names they now bear. Indeed, looking at the instruments generally, there is little more of any principle in them beyond what appears either in the windmill, or what may be exemplified by a light substance hung from a cord.

(To be continued.)

NOTES ON BLOWPIPE ANALYSIS.

By H. B. CORNWALL.

In a note published in the *American Chemist*, March, 1872, I stated that Van Kobell's iodide of potassium and sulphur test for bismuth gave also a marked reaction with lead compounds. The characteristic yellow sublimate which it affords with lead compounds is nearly as volatile as the real sublimate obtained by it with bismuth compounds, both of them being formed at a greater distance from the assay than the simple yellow coatings of oxides of lead and bismuth which frequently accompany them. The iodide of potassium and sulphur mixture constitutes a simple and very delicate test for lead, even in presence of a very large amount of bismuth, as experiments will show, and I direct the students to rely chiefly upon it; remembering only that the iodide of lead (?) sublimate is much more volatile than the simple yellow coating of oxide of bismuth or lead, which always lies near the assay. A few precautions are necessary in using the mixture as a test for lead, and also for bismuth to a certain extent.

Mercury compounds will often afford a yellow, sometimes a reddish sublimate with the mixture; sulphide of arsenic in large quantities, a yellow sublimate; sulphide of antimony, an orange, sometimes a reddish sublimate; cadmium compounds the yellowish brown coating of cadmium oxide, which might mislead beginners; all of these can be removed by a preliminary treatment with a moderate oxidising flame, to such an extent as not to interfere with the lead or bismuth reaction, and they should be so removed when present in large quantities. Finally, some tin compounds yield a yellowish sublimate with the iodide mixture, but it is very near the assay, and quickly becomes white on continuing the blast. These facts have partly been brought to my notice during practice with classes, and therefore will be of interest mainly to beginners, who are most liable to be deceived by the reactions given. The mixture is, however, highly to be recommended in testing for lead, having given indications of that metal in bronze and cadmiferous calamine, when all other blowpipe tests failed; the lead in the bronze was overlooked by an experienced chemist.—*American Chemist*.

University of Michigan.—We have received an account of the course of study pursued in the laboratory of analytical and applied chemistry in the University of Michigan: also a list of the professors, among whom we find the well-known name of Dr. A. B. Prescott, a list of the works used as authorities, &c.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, March 23rd, 1876.

JOHN PATTINSON, President, in the Chair.

DISCUSSION ON JONES AND WALSH'S DECOMPOSING FURNACE.

(Concluded from p. 268.)

MR. H. L. PATTINSON said he had visited the works of Messrs. Jones and Co., and he had seen the first pan, and more recently the larger pan, in operation and he could certainly bear testimony to the fact of there being no gas escape. Of course he could not say anything as to the quantity of the gas condensed. He was very much satisfied with the admirable way in which the material seemed to be wrought. He never saw a more beautiful sulphate in his life. There was not a lump in it larger than the size of a hazel nut, and even these lumps when broken showed a perfect decomposition. He thought that if Mr. Jones would give them some of the tests of the sulphate they would be interesting. Those which he got when he was there were very good indeed. If he charged his memory rightly there was something like 1 per cent of free acid, showing probably that there was not a very high temperature, and there was a very small quantity of chloride—three-tenths per cent—showing that the decomposition was very perfect. He thought it would be well to supplement some of Mr. Jones's remarks also on that point; if by any accident an insufficient quantity of acid had been added to the salt, they could correct that by adding a little acid during the process and before the charge was withdrawn. It was only necessary to sprinkle in the additional estimated quantity of acid. That was very rapidly disseminated through the mass, and thus succeeded in bringing it to a perfect decomposition. On the other hand, if there was an excess of acid, it was only necessary to put in a little salt; that also was rapidly mixed by the action of the machine and took up any excess of free acid. He thought that the output, even of the furnace which Messrs. Jones now had at work, could be very largely increased by a better draught. He thought Messrs. Jones would probably agree with him that the deficient draught was probably owing to their having, from the nature of the place, been obliged to take the flue below the floor. It suddenly dropped from the roof of the furnace under ground, then rose again after a considerable distance, and as they all knew that a pulldown draught was disadvantageous, they would probably with a better arrangement of the draught get a better result. The first furnace, he thought, was working much more satisfactorily, and, for its size, turning out a larger quantity of sulphate. The draught was, at all events, sufficient, even in the large furnace, to do away with any nuisance such as we have even in our well-draughted open condensing furnaces. There was no nuisance when the charge was drawn, and they all as practical manufacturers, knew what a nuisance it was having the batches imperfectly wrought. There was no gas that he could complain of, and he thought nobody could. There was a little pungent odour, but nothing to be a nuisance. He was very much pleased with the whole thing, and thought that when little improvements were made in the way of charging, by a hopper on the top of the furnace probably, and also by the alteration of the gear, so as to draw the charge out through a slide in the furnace bottom, a great deal of time would be saved, and he should think that probably instead of their getting three batches out in the twenty-four hours, there would be no difficulty in getting out four. He would be very much disappointed if, in the furnace his firm had now ordered and were proceeding to erect, they did not get out 100 tons per week.

Mr. NEWALL said he went over to Middlesbrough and

saw the furnace at work and was very much pleased with it, and thought it did the work very well. Of course they all knew they were very much at the mercy of workmen now-a-days; and at Washington they had had the same cause of complaint which they had had at Middlesbrough. He regretted that Mr. Clapham had not informed them what steps had been taken previously in the same direction. If the records of the Patent Office were examined it would be found that some twenty-seven years ago Mr. William Pattinson, of the Felling, took out a patent for apparatus almost identical with that patented by Mr. Jones. The difference was very slight; and if Mr. Pattinson's plan was examined it would be found that it had been apparently much more well considered than the specification of Mr. Jones. The drawings attached to Mr. Pattinson's specifications were working drawings; in the other they were rather the reverse; but Mr. Pattinson showed clearly that his plan could be carried out for these furnaces. He had proposed two pans, and of course would do double the work in the same time that was done in one, or very nearly so; but the two processes appeared to him so identical that he could not conceive a patent taken out for this process now. The whole of the mechanical arrangement for the operation in Mr. Pattinson's plan was complete. He had gear which drove the stirrer at a certain speed during the process of decomposition, and when that was completed he reversed the mechanism by a clutch and drove the stirrers again at four times the speed, so as to expel the sulphate at the end of the operation four times as quickly as it was stirred up before. He thought it was worth looking at as a better contrivance than the one before them; but otherwise the two plans appeared to him to be identical.

Mr. H. L. PATTINSON said he imagined that the essence of Mr. Jones's plan in opposition to his cousin, Mr. William Pattinson's patent was this—that the whole operation was completed in one pan and furnace.

Mr. GLOVER said that as Mr. Newall had mentioned the patent of Mr. Wm. Pattinson he might say that he happened to be at the Felling at the very time the plan was brought out and worked. He was there until it was discontinued, and he tested the products during the whole of the time. Unfortunately Mr. Wm. Pattinson did not carry out his process to the successful issue which Mr. Jones had done, and he thought that Mr. Wm. Pattinson would be the first to admit that that constituted a very strong claim to the patronage and sympathy of the trade. He recollected that at that time Mr. W. Pattinson's main object was to work balls. He worked the furnace for many months as a ball furnace. His great difficulty at that time was not so much keeping up the motion and working the material well, as to get a material for the tools which would stand the corrosive action of the sulphides. As Mr. Newall said, the machinery which was contrived and executed was almost perfect—the action of it was perfect. Mr. Pattinson saw it was necessary in applying it to a ball furnace, where the temperature was so high, to have a cooling apparatus, and he believed Mr. Pattinson specified water, though he used air. But he should think that at least twenty-five years had elapsed since the experiment was abandoned, and he thought that both morally, and even legally, Mr. Jones's patent deserved their support, and he believed that legally it would obtain it.

Mr. JONES said he was very glad Mr. Newall had named this matter, because it gave him an opportunity of explanation. His friend Mr. Hugh Lee Pattinson was himself over at their works amongst the first to see the furnace in operation, and at the time he told him of the furnace which had been designed by his relative, and also the use to which it had been applied; and he gathered from Mr. Pattinson's remarks at that time, that the main, if not the sole, use of this furnace was for carbonating.

Mr. GLOVER—We tried it for carbonating, but chiefly for balls.

Mr. JONES added that the machinery of it was described to him, but it was not till his return home from Sicily a few days ago that he was aware the furnace had been patented. The main principle of their patent was simply what had been described by Mr. Pattinson—that they did the whole of the operation at one time. They commenced and finished the operation, as it were, at one charge, and thus saved the labour of the twofold operation of having first to decompose the salt in one vessel, and then afterwards transfer it into another vessel to be finished, which, to his mind, would render the furnace of Mr. Pattinson, even supposing it had been applied to decomposing, so costly to work as to very largely, if not entirely, nullify the benefits to be obtained in their patent by cheapening labour.

Dr. LUNGE said he had not seen the patent of Mr. Wm. Pattinson, but he was informed that Mr. Pattinson distinctly disclaimed the use of revolving machinery in the acid pans, and that constituted a very important difference. Of course, by that plan the breakage of the pans would be very much what it is at present.

Mr. MOND said he gathered, from what the several speakers had said, that the work in this furnace must be essentially different to the ordinary pan. Both Mr. Clapham and Mr. Jones remarked the evolution of the gas was constant, and he also gathered from Dr. Lunge, in conversation, that the mass never got into a solid state. If that were so, he should wish it to be explained; because, in that case, it was not only a new furnace, but an entirely new process in making sulphate, and appeared to him to be a very important innovation. Might he ask Mr. Jones to explain if he was right in this supposition?

The PRESIDENT thought that at one time, in the beginning of Mr. Jones's experiment, the mass was fluid at the commencement of the batch.

Mr. JONES—Not very fluid. The salt took the acid quickly.

The PRESIDENT—You added the salt very quickly?

Mr. JONES—Yes.

Mr. GLOVER—Have you ascertained accurately the percentage of sulphuric acid you used on the salt?

Mr. JONES said that Mr. Dyson, manager for Messrs. Muspratt, Bros., and Huntley, was over at their works last week, and took charge of the furnace while he was there. He was allowed to do what he liked with it. He weighed one charge of the materials taken, and the results were as follows:—Common salt, 3 tons 10 cwt.; sulphuric acid of 140°, equal to 2 tons 17 cwt. 3 qrs. of 170°.

Mr. CLAPHAM—What percentage?

Mr. JONES said he had not worked it out, neither had Mr. Dyson, but it was 140° acid, equal to 2 tons 17 cwt. 3 qrs.

Mr. GLOVER—Of oil of vitriol?

Mr. JONES—Yes. The finished sulphate which he got out he weighed at 3 tons, 15 cwt., and estimated that he had left 5 cwt. of sulphate of soda in the furnace, making the total weight of sulphate of soda produced 4 tons. He could not get it all out; it was drawn out by a hand rake.

Mr. HILL said by that Mr. Jones would make out that he had used 82½ per cent of acid of 170°, and got 114 per cent of sulphate upon the salt charged.

Mr. JONES said he had not worked it out.

Mr. HILL said this was what the figures which Mr. Jones had given brought out. There was just a doubt about the 114 per cent of sulphate on the salt charged, because the general experience on the Tyne led to a very much lower result, unless the salt was very dry.

Mr. JONES—The sulphate obtained was 4 tons.

Mr. HILL—Do you know the moisture in the salt?

Mr. JONES—No; but I think it was dry salt. You could not tell accurately from one batch.

Mr. HILL—That would account for a high percentage of sulphate.

Mr. JONES—There are no fluxings in this process. There is no possibility of any loss. I have not worked it

out in percentages. These are Mr. Dyson's results of his own work. He was allowed to have charge of the furnace for three days and two nights to do what he liked.

The PRESIDENT said the question which Mr. Mond wanted answered was this:—In what condition the salt and sulphuric acid were mixed together? Was all the salt put in at first, and a small quantity of acid added from time to time till all had been added? Or were the salt and acid put in in small quantities?

Mr. WALSH—We put in two tons of salt first to cover the pan bottom, and then turn on the acid tap, running the acid in about twenty minutes, and then throw in the remainder of the salt.

The PRESIDENT—Is the whole of the acid put in at once?

Mr. WALSH—Yes; it takes twenty minutes to run in, in 5 ton charges, and while the acid is running, the rest of the salt is put in.

Mr. GLOVER—The batch is never fluid?

Mr. WALSH—Well, it is in what you may call a thick pulp. It never becomes thin as in the ordinary decomposing pan. It is pasty and stiff.

Dr. LUNGE said he noticed specially the point which Mr. Mond had raised. It never became fluid, and there was not the slightest tendency to boil over. He asked if they used any tallow, and they said no.

Mr. CLAPHAM, in reply to Mr. Mond, said the sulphuric acid was very strong, and there would not on that account be such a liquid mass in the furnace as if it was a very weak acid. The batches he saw worked were not what he would call fluid. They were sufficiently pasty—he thought that was the correct term to use—for the knives to go through.

Mr. GOODMAN thought he would not offer any observations as to theory, because what he could say was simply as to practice. He would much rather say something about the machine after trial. He thought a great deal of credit was due to Messrs. Walsh and Jones for the way in which they had worked out this furnace. He thought a great deal of time was lost between the filling in of the salt and the withdrawing of the charge. That was of course merely a mechanical operation which would probably require a little time to work out. He believed that the charge had taken five and a half hours to work, and if it took from eight to nine, he could see that it must be either from the laxity of the draught or the long time it took to feed the salt in and get it out, because it sometimes sticks a little to the bottom. But these were matters of detail, and he had no doubt that an hour and a half, or something like that, ought to be saved on each batch in twenty-four hours, so that practically he had no doubt they could turn out 20 to 25 per cent more sulphate with a more carefully considered arrangement. There had been an objection raised to the bottom door, but he believed that the principal objection to the arrangement was that it was a sliding one, and that if the door stuck they could not get at it. There was no objection to the drop door, it was simply the sliding door; and there had been a doubt expressed by some parties as to whether a bottom door could be made tight. He believed Mr. Walsh's practice went to show it could be easily made tight, and that there was not any doubt as to the tightness of the bottom door in his case; but as he said the simple difficulty was to get the slide out if it was stuck in the bottom. But these were all mechanical arrangements which he would rather not linger upon at present. At a future period they would no doubt have the opportunity of seeing the revised furnace for which he had drawn out the working plans. In a very short time one or two manufacturers would have them in work on the Tyne, and he was quite confident that the eighty tons which he thought Mr. Clapham spoke about in his paper could, first of all, be increased if the pan was about one-fifth more capacity than that of the pan which they were at present working. From one-fifth on eighty they would see what the result was, and by gaining about three or four hours out of the

twenty-four they would have a further gain on the whole result. So that dealing simply with practical matters, he believed they would be able easily to get up to 100 or 120 tons. Of course there would be improvements made from time to time in this furnace. Some people still considered that over-head gear in matters of this kind was better than under gear. These were matters which only time could work out, at present what would suit one person's practice would not suit another's. For instance, when you brought the salt overhead it was more convenient to have under gear; under other circumstances it would be more convenient to have overhead gear. But these were mere matters of detail, and he thought they would be able to arrive at satisfactory conclusions if they satisfied their minds on the chemical portion of the work.

Mr. PATTINSON, with respect to the wear and tear of the furnace, said, of course he had no experience, and probably no one had any experience, because it had not been in operation long. It was a most vital point, and time only could clear it up. Perhaps Mr. Jones would give them any results they had arrived at.

Mr. JONES said there was not much to be said upon that point. But the first furnace they put up was put up with a very slight pan; he thought the metal would not be more than $1\frac{1}{2}$ inches thick. That pan was soon cracked, for the reason that all the work had been very home-made, and the pan put up too close to the fire; it was simply cracked by the heat of the fire, for being set upon pillars the radiation of heat caused unequal expansion. But, in the pan which he had described, which had been in regular work since last November, there was no appreciable wear and tear to this day. It had been carefully examined and measured in every part. There was an air-way between the edge of the pan and the fire, and therefore the fire had no direct effect upon it; and gentlemen would see that when there was no bottom heat going under the pan, and heat passing over a considerable distance above the surface of the pan, there was really very little risk of its breaking. He did not know what might be the life of a pan; it would be mere speculation to give a guess at it. But there was no visible wear and tear in the pan at this day, which was begun last November. With regard to the internal machinery, he had already stated, that while it was of wrought-iron there was a tendency in it to bend, especially when the charge became of a thick pasty state. The wrought-iron then having a considerable strain upon it, the arms were apt to bend a little out of shape. That, however, had not been observed since the wrought-iron arms had been replaced by metal arms, and that was the reason why the original furnace had been stopped, in order to have those wrought-iron arms taken out and metal arms put into it. There was no difficulty whatever in working it with metal arms of sufficient strength, and with metal scrapers and ploughs; and the wear was reduced practically to that upon the scrapers, and which was really very little. They only kept one smith at that class of work in their own works, and he really had nothing to do at this machine now. The smith used to be kept going constantly repairing the tools for the old decomposing pot.

The PRESIDENT said the matter had been pretty fully discussed, but one point had not been made very clear to his mind, and he thought it would be very advisable to have information upon it, which would perhaps be forthcoming at the next meeting—that was, as to the exact quantity of hydrochloric acid which was produced. Not only did they want to know the kind of condensation which had taken place, but they wanted to know how much muriatic acid had been obtained from a certain quantity of salt decomposed. That had not been very clearly stated by Mr. Jones, and probably, as he said, they had no data to make the calculation. But he hoped that at the next meeting Mr. Jones would be prepared to state how much hydrochloric acid was obtained from a certain amount of salt. Whether Henderson's process was likely to supersede all the others, and sweep the present plant

off the face of the earth they could not tell; but it was quite clear, he thought, that Messrs. Jones's furnace was a very great improvement on our present decomposing plant, and they ought to be very much obliged to those gentlemen for bringing before them such an important discovery. There was evidently a very material saving of labour and labour of a disagreeable kind, which was a very important consideration in these times. He had great pleasure in moving that a vote of thanks be given to Mr. Clapham for his paper, and to Mr. Jones and Mr. Walsh for attending there to give them the explanation of the working of their furnace.

CORRESPONDENCE.

ANALYSIS OF MANGANESE ORE.

To the Editor of the Chemical News.

SIR,—From his letter (CHEMICAL NEWS, vol. xxxiv., p. 19), I fear Dr. Phipson has not understood my query on the determination of the oxides of manganese, and I must therefore request the opportunity of explaining myself further. As Dr. Phipson is no novice I erroneously imagined that he would at once appreciate my meaning.

In the CHEMICAL NEWS (vol. xxxiii., p. 243) Dr. Phipson published in your columns a very elaborate analysis of a sample of manganese ore, which your contributor had found to contain 72.17 per cent of MnO_2 . There was an additional quantity of manganese beyond the amount present in the above form, and this Dr. Phipson assumed to exist as Mn_2O_3 , 6.20 per cent being thus accounted for.

In my last letter, I, in effect, asked if Dr. Phipson had any means of distinguishing this Mn_2O_3 from a mixture or combination in atomic proportions of MnO and MnO_2 ($=Mn_2O_3$), and I receive the unsatisfactory answer that Dr. Phipson "discovered the manganic oxide (Mn_2O_3) in a very simple manner, namely, by determining in the first place the total quantity of oxygen, and in the next the total quantity of manganese. These two data are quite sufficient for the purpose."

As well might Dr. Phipson attempt to distinguish acetate of ethyl from butyric acid (both of which have the same empirical formula) by determination of the carbon and hydrogen as think he can tell Mn_2O_3 from $MnO + MnO_2$ by merely ascertaining the proportion of manganese and oxygen, for a glance will show that the percentage composition is the same in each case.

Unfortunately, as a provincial chemist, the French edition of H. Rose's chemistry is not readily accessible, but I think the author would scarcely thank Dr. Phipson for fathering such a method on him.

My question was asked in perfect good faith, as I really thought there might be some means of arriving at the information sought. As it is I will ask your correspondent a few other questions, and challenge him to reply.

1. How does Dr. Phipson know that the 6.20 per cent of Mn_2O_3 which appears in his analysis was not made up of 3.41 of MnO_2 and 2.79 of MnO ?

2. If he does not know, how did he distinguish the 3.41 per cent of MnO_2 from the 72.17 admitted to be present?

3. What process was employed for the determination of the main quantity of MnO_2 , and would not the amount found include the 3.41 per cent, assuming the latter to have any existence?

4. If the result of the determination of the MnO_2 ($=72.17$) represents the total quantity of that oxide present, must not the remainder of the manganese necessarily have existed as MnO and not as $MnO + MnO_2$ ($=Mn_2O_3$)?

5. If the last question is answered in the affirmative, has not Dr. Phipson counted his oxygen twice over?—I am, &c.,

ALFRED H. ALLEN.

Sheffield, July 15, 1876.

DR. J. W. HEARDER, F.C.S.

To the Editor of the Chemical News.

SIR,—Mr. Mendola, in his attack on Dr. Hearder, has, I think, entirely mistaken his grounds. The letters F.C.S., F.R.S., or F. any other S., show and mean nothing whatever except that the holder is supposed to have some interest in the work of the said S., and that he is held in sufficient estimation by the members to be permitted to join them. I have not the smallest doubt that this is fully and perfectly understood in its proper sense by every person of very ordinary intelligence. What little position such a qualification as this gives is undoubtedly made use of one way or another by almost every member of every Society in existence. It may not be that every one sends it out by thousands, but even the leaders of the Chemical Society are not free from this fault, if it is a fault. To print it on the title-page of a book, or in fact anywhere else (except in matters strictly connected with the Society), is not appreciably different to printing it on a circular. It would appear that Mr. Mendola has an exalted idea of the possible value of the Fellowship of the Chemical Society. If a brass farthing is polished, and held at a respectful distance from the eyes of the public, perhaps some may mistake it for a sovereign; but I think to attempt to persuade the educated classes that the Fellowship of a Society is any qualification is an insult to their common sense neither Dr. Hearder nor Mr. Griffin would be guilty of. I am not aware that the Fellows of the Royal or any other Society attempt to hide their light under a bushel if it can be exhibited to their own moral or pecuniary advantage, and the same remark applies to the whole class of what may be called the Societies of Specialists. Men of business, of which a large proportion of the Chemical Society is composed, do their advertising in their own way; those who are not men of business simply do it in another way amongst their friends and acquaintances, and make, or think they make, a moral profit instead of a pecuniary one. When a Fellow of any Society makes it known that he is one, as a matter of business, he simply takes an indirect means of giving references to his personal friends who have signed his application,—i.e., the fact of his being a member is, to a very limited extent, a moral guarantee that he is not absolutely unknown. If the Chemical Society transforms itself into a strictly professional Club, and goes out of business in the printing and publishing line except for its own members, then the use of the letters F.C.S. by the holder, except in matters strictly connected with the Society, might be considered improper.

It is an open question whether those who are raising the cry of discontent are not a few who—not being eligible or qualified for admission to the Royal Society—wish to polish their farthing up to the utmost limits, and try to make it look like the real thing. To my mind the only way to do this will be to admit all as Associates at first, and afterwards make the Fellowship conditional on the contribution of original papers or work to the Society. This revolution might include the whole of the existing Fellows who had not contributed any original work since their election. The rule might be that Associates should be elected as Fellows on the publication of any Paper of theirs in the *Transactions* after it had been accepted and read at one of the meetings. This would give the Fellows a slightly better position than they now hold, and would no doubt considerably increase the amount of original work published, more especially if all Fellows after their election were liable to be called on for Papers at intervals of say not less than one year. This would do what neither blackballing nor raising fees could do, and would be practically equivalent to an examination without its weak points. The position of the Society can be improved better without the use of personalities, and if the discussion of the matter is left entirely to the Council it will be better for all parties concerned. When discontented members descend to personal attacks in public journals,

the Society must be getting in a bad way, and it is time for the Council to take the matter in hand.—I am, &c.,

THOS. FLETCHER.

Warrington, July 18, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 26, June 26, 1876.

Maximum of the Possible Repulsive Power of the Solar Rays.—M. G. A. Hirn.—The attention of the scientific world has been latterly drawn to the singular phenomena which Mr. Crookes has studied with the radiometer. The conclusion which has presented itself to the mind of many is that these phenomena are due to an impulsive action of the luminous rays, and that it is thus demonstrated that light is a movement of ponderable matter. Nevertheless, the phenomena discovered by Mr. Crookes have been elucidated, if not in their cause, still in their form and their starting-point. The ingenious counter-proof to which M. Arthur Schuster has submitted them places it beyond doubt that it is by no means the direct action of the rays emanating from the luminous source which determines the movement of the discs of the radiometer, but that the repulsive power here called into play has its seat in the walls of the transparent vessel which serves to contain the mill, and that this power is set in action by the pencil of rays directed upon the apparatus. As the true explanation of the totality of the phenomena has not yet been given, and as the hypothesis of the materiality and of the impulsive force of light will probably not soon be abandoned, the author thinks it useful to submit this hypothesis to the test of the method of successive elimination. Mr. Crookes has calculated the apparent repulsion exerted by the solar rays at 1 grm. per square metre. This pressure is more than one thousand times greater than the maximum value possible for reflecting bodies, and more than two thousand times superior to the maximum value possible for absorbing bodies. We may, then, affirm that the phenomena which Mr. Crookes has made known are nowise due to the effect of an impulsion of light, and do not imply the idea of mass of density as regards radiant light and heat. However carefully the vacuum in the vessel enclosing the radiometer or torsion balance may be made, there remain, nevertheless, quantities of gas or vapour relatively enormous. The maximum pressure which the solar radiation can exert upon 1 square metre of absorbing surface is 0.0004157 grm.: let us suppose that the discs of the radiometer are 10 square centimetres, the maximum pressure upon them will be 0.00004157 grm., or a little more than $\frac{1}{2400000}$ th of 1 grm. The slightest agitation of the small quantity of gas remaining in the apparatus will produce upon the radiometer pressure comparable to this. However transparent may be the glass case of the radiometer, it still absorbs a part of the calorific or luminous rays; one of its surfaces is heated more rapidly than the other. This inequality of temperature necessarily determines electric polarity, or the manifestation of static electricity. The vacuum, it is said, is so perfect that the electric spark cannot traverse the apparatus. But electric attractions and repulsions traverse the vacuum. However feeble may be this cause of attraction and repulsion, it may nevertheless have a considerable value in comparison with our maximum of 0.00004157 grm.

New Experimental Considerations on the Radiometer of Mr. Crookes.—M. A. Ledieu.—The author's experiments become less and less favourable to the theory of the apparatus based upon the movements of gases and vapours remaining within the glass case after the vacuum

has been made. This theory, as we know, is subdivided into various doctrines, of which a very complete and lucid exposition has been given by M. Bertin in the June number of the *Annales de Chimie et de Physique*. The capital objection which mechanicians oppose to these different explanations is, they are all reduced to admit, that the radiometer is an instrument of reaction. But in such apparatus, having regard to the impossibility of the motive power being rapidly produced with a sufficiently constant intensity, there ensue merely rotations accompanied by retardations and bounds far from being reconcilable with the perfect regularity of the radiometer. Moreover, the theory in question expressly requires that there shall never be an equilibrium of temperature between the gas in the case and the discs of the radiometer. But how are we to admit that in every experiment this equilibrium is not ultimately established? Moreover, the rotation ought to stop at last instead of maintaining itself indefinitely at the same speed. The author then cites certain experiments difficult to explain by the supposed movement of gases in the interior of the apparatus. Thus the instrument was heated nearly to redness, when it commenced turning, but the rotation was sensibly accelerated by the momentary presence of a single flame, which joined its action to that of the radiant heat. An apparatus was constructed with discs exclusively polished. On throwing a pencil of solar rays upon one of the two hemispheres of the glass case a perfect rotation was obtained, without interruption, and as free and rapid as with an ordinary radiometer fully exposed to the light. The author bases his explanation of the phenomena upon a mechanical action of the "ether" perpendicular to the direction of its rays of propagation, and not in the same direction as these rays. This interpretation is calculated to calm the legitimate disquiet of the partisans of undulation. In Germany there is a leaning to an explanation based upon electricity. They rely upon the experiment that when a radiometer with discs exclusively polished, and where one of the hemispheres of the case is traversed by a continuous electric spark, the instrument takes a rapid rotation always opposite to the direction of the spark, this direction being understood according to the common convention. "In any case the radiometer of Mr. Crookes seems to us a serious instrument, and not a paradoxical apparatus destined to enjoy an ephemeral scientific repute and then to rank as a mere physical amusement. Its experimental study, pursued under all modifications and with an indefatigable perseverance, will certainly lead to important results as to the mechanical properties of the ether."

Process for the Manufacture of Soda from Seaweed by Endosmotic Lixiviation.—M. L. Herland.—The author gives the following reasons for the depressed state of the seaweed industry: the weed is collected indiscriminately without regard to its greater or less richness in iodides or other useful salts. The weed destined for incineration is dried on the shore in the open air, whence results a decomposition and a loss of salts from the spray of the sea, dew, rain, &c. The process of incineration itself is the main cause of the weakness of the product in iodine, as a certain quantity is volatilised, but it is chiefly to the siliceous sand mixed with the weed that the great loss is due. In fact, silica at high temperatures reacts upon the iodides, producing alkaline-earthly silicates, and eliminating a certain quantity of iodine. The author, therefore, proposes the following method:—The fresh weed is placed in baskets of iron-wire, moved by a turning crane, and steeped in a series of vats containing about 50 kilos. of good quicklime per cubic metre of water, and arranged in circular batteries. The weed passes in succession from vat to vat, and is exhausted of all its useful salts. The same series of successive immersions is pursued with fresh weed until the first vat marks 4.3° to 4.5° on the hydrometer (pèse-sels, probably a Baume's glass adapted for saline solutions). During this operation a double exchange takes place between the weed and the lime-water, by means of endosmosis. The time of steeping

is, on the average, from forty to sixty minutes. With a set of ten vats of 6 cubic metres it is possible to lixiviate in fifteen hours 50 tons of 1000 kilos. each of fresh weed. The second stage of the operation consists in evaporating to dryness the successive saturated lyes, and then calcining very slightly in presence of a slight excess of carbonate of potash, carrying the process to the commencement of the aqueous fusion. This procedure yields a soda very rich in soluble salts, in utilisable salts of potash (chloride and sulphate), and in alkaline iodides. The incineration process gives, on an average, 15 per cent of potash salts, and 1 per cent, at the outside, of iodide. The new process yields 45 to 50 per cent of utilisable salts of potash, and 2½, 3, or even 5 and 6 per cent of iodide if the weeds have been well selected. The residual weeds are still applicable in agriculture.

Certain Experiments made with the Balance of Crookes.—M. G. Salet.—The author makes the discs of his radiometer of mica, and blackens both on the same side. He considers his results difficult to reconcile with the idea of a direct impulse due to light or to the ether, but contrary to the theory which seeks to explain the movements of the radiometer by the disengagement of gases condensed on the discs. Can the minimum quantity of gas which remains in an apparatus exhausted with such care suffice to occasion the movement, according to Tait's theory?

Certain Derivatives of Normal Pyrotartaric Acid.—M. Reboul.—A description of the salts of zinc, copper, lead, silver, soda, and of the normal pyrotartrate of ethyl.

Volumetric Determination of Formic Acid.—MM. Portes and Ruysen.—The authors remark that the quantitative determination of formic acid in acetic acid has a certain importance in solving the problem of the determination of wood-spirit in spirit of wine. They pour into a flask containing 5 grms. acetate of soda 25 c.c. of a solution at 10 per cent of the mixture in question, and add 200 c.c. of a solution of sublimate at 4.5 per cent (9 grms.). It is heated from one hour to an hour and a half in the water-bath until the supernatant liquid has become perfectly limpid. The whole is then made up to the volume of 500 c.c. and filtered. It is then ascertained, by means of a graduated burette, how much of the reduced liquid is required to saturate 1 grm. of potassium iodide. The number found by calculation must be corrected by the addition of one-fourth.

Arragonite observed on the Surface of a Meteorite.—J. Lawrence Smith.—Arragonite has been found as an incrustation on certain specimens of meteoric iron from the so-called Mexican Desert (Bolson de Mapini), situate in the provinces of Cohahuila and Chihuahua. The author is of opinion that the incrustation has been formed since the fall of the meteorite.

Compounds of Carbon Found in Meteorites.—J. Lawrence Smith.—The author has pursued his studies on the crystalline hydrocarbons derived from terrestrial irons and doubtful meteorites, like that of Oviak, searching for hydrocarbons in the carbon combined with these irons. That of Oviak contains a notable proportion of this carbon. There was in these irons a substance similar to that already found in meteoric graphite and carboniferous meteorites. It has the same strong odour, and crystallises in small needles. If heated on platinum-foil it melts readily, and at higher temperatures it burns with a flame, and disappears.

Use of Calcium Chloride in Watering the Paths of Promenades and Public Gardens.—M. A. Houzeau.—The nature of this paper may be understood from its title.

Experimental Researches on the Action of Aniline Introduced into the Blood and the Stomach.—MM. V. Feltz and E. Ritter.—The authors describe the symptoms produced, both in men and dogs, by small doses of magenta. It is fortunate for them that they are not resident in England.

A Differential Radiometer.—M. W. de Fonvielle.—The author has had constructed a radiometer, the discs of which (of mica) are coated on both sides with lampblack, and the case is blackened in the same manner over half its surface. If the light is received perpendicular to the diametral section which separates the transparent hemisphere from the darkened hemisphere the apparatus remains motionless. If, on the contrary, the diametric plane is inclined to the left, the left-hand discs, more strongly illuminated than those on the right, are repelled more energetically, and the radiometer takes a regular movement from left to right. The same phenomenon is observed in the inverse direction if the diametric plane is inclined to the right. The rotation is the most rapid possible when the diametric plane is rendered parallel to the rays of light which illuminate the apparatus.

Researches on *Cypressus Pyramidalis*.—M. Hartsen.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 9, June 29, 1876.

The Radiometer of Mr. Crookes.—Since the commencement of the century much attention has been paid to the electric, magnetic, and mechanical action of light. The author in the third volume of his "Repertoire d'Optique" has analysed at length the experiments made by Sommerville, Barlocchi, Valt, Zantedeschi, Matteucci, Faraday, Davy, Moleyns, &c. Valt alone (p. 1011) obtained under the action of light the orientation, if not the rotation, of suspended discs, all other attempts having led to negative results. If M. Récamier caused his discs to revolve under the influence of light under closed bells, it was certainly because he set in action gaseous currents. Mr. Crookes obtains indefinite rotations with extreme facility. His experiments, which constitute one of the most brilliant discoveries of the age, engage all minds, and are like an enigma on which no one has yet given the final decision. It is time for the Academy of Sciences to elect a commission to study these phenomena from all sides.

MISCELLANEOUS.

Death of Dr. Hearder.—The Plymouth correspondent of the *Pall Mall Gazette* telegraphs on the 17th inst.,—Dr. Jonathan Hearder died last evening from a sudden paralytic seizure. He was the last remaining of the group of men who made Plymouth famous for scientific discoveries forty years ago. Dr. Hearder's researches in science, especially in connection with electricity and chemistry, were not extensive, but profound. He had made his name well known among the leading physicists not only of England but Europe and America. Almost at the outset of his scientific career an accident befell him, which, in the case of a less determined lover of knowledge, would have put an end to research. While experimenting with a fulminating compound he was deprived of sight by an explosion. Yet his chief honours were won after that event. He was intimately associated with Sir William Snow in his electrical researches. His own discoveries and inventions in connection with the induction coil and the therapeutic appliance of electricity were many and valuable. Dr. Hearder was one of the earliest to perceive that a telegraphic cable across the Atlantic was not only important, but practicable, and he invented a cable for which he took out a patent, a slight modification of which was ultimately adopted for Atlantic telegraphing. Dr. Hearder had a marvellous memory, and was never at a loss for a fact or a date. He was a zealous lover of all matters connected with local antiquities and history. The bent of Dr. Hearder's mind was quite as practical as it was investigative. He invented special forms of stoves, gas and other, and was a specialist in the matter of fishing gear. He not only contrived medical electric apparatus, but practised as a medical electrician, and was electrician to the South Devon Hospital.

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INFUSORIA AND NITRATES.

By T. L. PHIPSON, Ph.D., F.C.S., &c.

SOME very interesting observations regarding the reduction of nitrates by bacteria have recently been made by M. Meusel. It has been long believed that the nitrites found in waters are due to the oxidation of ammonia, but the author just named has proved in a satisfactory manner that they are not necessarily so produced. Water containing no compound of nitrogen except some alkaline nitrate was found after a certain time to contain no nitrites: this reduction was the effect of numerous bacteria visible in the microscope. It was stopped at once by phenol, salicylic acid, benzoic acid, alum, and salt. The following experiment shows under what circumstances this phenomenon occurs:—

A little pure water, containing some bacteria, has an alkaline nitrate added to it. At first there is no reduction, but after the addition of certain organic substances, more especially carbohydrates, such as sugar, &c., nitrites are produced at once and rapidly. Recently distilled water, mixed with sugar and a little alkaline nitrate, then boiled in a long-necked flask, the end of which is closed during ebullition, showed no reduction after many weeks.

The conclusions drawn from these experiments are—That the nitrites found in ordinary waters are due to bacteria; that the latter are the agents of the transmission of oxygen, even when this substance is combined, and that this is probably the reason they are so dangerous to man.

On repeating these experiments with very dilute solutions of permanganate of potash, without the addition of any organic substance, I find the bacteria killed simultaneously with the reduction of the salt. I have also found that when a little too much nitrate of potash exists in the water no reduction takes place, and the bacteria are also rendered immovable.

Now M. Meusel has also asserted that nitrates are useful as manure, not only by the nitrogen they contain, but on account of the oxygen they supply to bacteria, which enables the latter to destroy cellulose, &c. If this is the case, it would appear, at first sight, that nitrate of soda would prove a more valuable manure than sulphate of ammonia. But not long since I applied sulphate of ammonia and nitrate of soda to two small plots of the same pasture land in such quantities as to supply the same amount of nitrogen in each case. 8½ cwts. of nitrate of soda, and 6½ cwts. of sulphate of ammonia were used in this experiment, and the result was as nearly as possible identical in both cases. As with the bacteria, when either substance was applied in excess the grass was killed, and turned brown or yellow within three days. When applied in the most favourable proportions the yield in both cases was almost identical. Now 6½ cwts. of sulphate of ammonia supplied no available oxygen, whilst the 8½ cwts. of nitrate of soda supplied about 1½ cwts. of oxygen, the quantity of nitrogen being the same. Yet there was no apparent result for this difference of oxygen.

Now, if M. Clöez's theory is true, that C, H, and N are assimilated by plants as CO₂, HO, and NO₂, and that NH₃ in the soil or the manure becomes NO₂ to be assimilated, then the atmosphere would have supplied to the sulphate of ammonia the extra 1½ cwts. of oxygen in question. This, of course, would require rather more time, and such, in fact, was the case in my experiments, the nitrate being the quickest of the two by about eight days.

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REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 26.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

Regeneration of Manganese according to Weldon.—Recently Weldon has completely succeeded in attaining the object aimed at by so many. C. Binks and J. Macquenet had previously sought to revivify the chloride by precipitating it with the quantity of hot milk of lime needful for decomposition, passing a current of hot air through the liquid, and utilising the precipitate thus converted into higher oxides in place of fresh manganese. But Weldon was the first who succeeded in making the process technically applicable. His most essential improvement consists in the point that he uses not a sufficient quantity of milk of lime, but an excess. Considering the importance which Weldon's process for the regeneration of manganese has already attained in the modern manufacture of chlorine, since its commercial value is fully proved by its introduction in many establishments, especially in England, it may be considered permissible to describe its principles at greater length than the procedures already mentioned. The following account is founded partly on Mr. Weldon's paper in the CHEMICAL NEWS (vol. xxii., p. 145), and partly on his letter to Dr. A. W. Hofmann, dated March 12th, 1874.

Whilst, according to Weldon, hydrated manganous oxide diffused in water can be only oxidised to manganic oxide, Mn₂O₃, by forcing oxygen through the paste, it is possible, in the presence of lime or magnesia in excess, to convert the whole of the manganese into peroxide. The latter remains united with the lime as a compound, CaO, MnO₂, or CaMnO₃, calcium manganite. This may be regarded either as an analogue of the hydrated peroxide of manganese, or as manganic oxide, Mn₂O₃, in which an atom of manganese is replaced by lime. Hence it follows that 1 mol. calcium manganite requires exactly as much hydrochloric acid in the preparation of chlorine as 1 mol. of Mn₂O₃. Nevertheless it is advantageous to oxidise the manganous oxide with the aid of lime, since, in the first place, the same amount of manganese performs double the duty as if it had been only converted into manganic oxide; and, secondly, the oxidation is effected with far greater ease in presence of an excess of lime. This is probably because manganous oxide is somewhat soluble in pure water or in solution of calcium chloride, and thus retards the oxidation. At least it has been experimentally proved that salts of manganese decidedly retard the progress of oxidation. If, on the other hand, there is an excess of lime, a brown solution of calcium manganite is rapidly formed, which, as experiments prove, greatly accelerates the absorption of oxygen by the deposit of manganous oxide.

Latterly, however, it has been found possible to complete the oxidation of the manganese by an increased current of air along with a diminished dose of lime. Under these circumstances we may assume the formation of an acid manganite, CaMnO₃, H₂MnO₃. In fact, in exceptionally successful operations, calcium manganite has been obtained in which only 1 mol. of lime was present to 2 mols. of peroxide of manganese. In most cases the manganese paste has the following composition:—

0·80 = MnO₂,
0·20 = MnO,
0·28 = CaO.

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."
† *Technologist*, 1862, Sept. 27. *Wagner, Jahresberichte*, 1862, 237.

That the lime in the paste is chemically combined, and does not exist as a mere admixture, may be inferred because the product is perfectly neutral, and because lime cannot be withdrawn from it by a solution of sugar. The manganous oxide can also be oxidised by air when the lime is replaced by baryta, strontia, or soda.

On a practical scale the process is carried out as follows:—The manganese liquor from the chlorine stills is let off into tanks provided with agitators. In these it is treated with finely-divided carbonate of lime, to neutralise the free acid and to throw down any iron which may be present as oxide. The liquid is then pumped off into settling-vats, in which it is left to become clear. Hence the clear neutral solution is run into the oxidiser—an iron cylinder, 3'66 metres in diameter and 6'61 in height. Into this, near the bottom, opens a narrow pipe which conveys steam, and one or more wider air-pipes. After the liquid has been heated to 55°–75° by a current of steam, milk of lime, prepared from finely-sifted hydrate of lime, is run in as rapidly as possible, whilst air is simultaneously forced in until no manganese can be detected in the filtrate. This occurs when not only all the manganese is converted into manganous oxide, but when an excess of hydrate of lime is already present. For this purpose 1'15 to 1'45 mols. lime are required to 1 mol. manganese.

To be continued.)

ERYTHROGEN AND SOME OF ITS COMPOUNDS.

By LEWIS THOMPSON.

WHEN we look at the vast extent of our gas-making industry, and the number of persons interested in keeping up an artificial cry about the "sulphur in gas," we may well wonder that so little has yet been done to remove the exaggerated defect. But this display of inventive poverty is not altogether without its value, for it teaches us, beyond the possibility of doubt, that Governmental interference with any manufacturing industry is not a rapid road to improvement.

About twenty-nine years ago I first became aware of the fact that such articles as liquor ammonia and carbonate of ammonia, when made direct from gas-liquor, always contained more or less of a peculiar red substance, which contaminated the ammoniacal products, and rendered them unfit for use in silk dyeing and some other arts; and a careful examination convinced me that this red matter was not sulphocyanide of iron, but had some mysterious connection with bisulphuret of carbon. I have often separated this red matter from gas-liquor, and also from gas-lime refuse, and both shown and given it to several of my friends, but it has always been so mixed with other impurities that no decisive opinion could be formed regarding it, except the mysterious connection above alluded to. The mystery, however, appears to admit of solution if we suppose the bisulphuret of carbon to be a halogen body like cyanogen, and therefore capable of uniting directly with metals; a supposition which I have carried out into practice by combining it to potassium, with which it forms a compound remarkable for the blood-red colour of its solutions in water and alcohol, and therefore I propose to give the name Erythrogen (from "Erythros," red) to the bisulphuret of carbon in its combinations, and Hydro-Erythric Acid to the acid set free from the solution of the erythride of potassium by an acid.

Not to trouble your readers with any superfluous remarks, I will describe in as few words as possible the mode of making the erythride of potassium, from which the hydro-erythric acid and other compounds may be produced by the usual chemical processes.

To make erythride of potassium, we must begin by making an amalgam of potassium, consisting of about 1 part by weight of potassium and 150 of mercury, which is easily done by fusing them together under naphtha.

When cold pour off the naphtha, and having wiped the surface of the amalgam with a dry cloth, transfer it as quickly as possible to a dry stoppered bottle, and add to it a quantity of bisulphuret of carbon equal to about three times the weight of the potassium employed; then shake the whole well together until the mixture becomes solid, when it must be set aside for a few hours to cool and complete the combination. After this, the surplus bisulphuret of carbon is to be driven off by a current of air, and the erythride of potassium separated from the mercury by water and filtration in the usual way. But it is worthy of notice that a part of the mercury, under the influence of the potassium, is converted into erythride of mercury at the same time, and this holds out a hope that such metals as lead and antimony in a very minute state of subdivision may be useful in purifying coal-gas from bisulphuret of carbon; and, in fact, I am now actually trying the pyrophoric mixture of lead and charcoal formed by heating the tartrate of lead, and it seems to promise well. When the hydro-erythric acid is thrown down by acids from the solution of erythride of potassium, much of it is decomposed in carbonic acid and sulphuretted hydrogen, except at a very low temperature; but in either case it forms a fixed, chocolate-red, granular powder, most remarkably like selenium.

Sandy, Bedfordshire, July 22, 1876.

ON THE AMALGAMATION OF IRON AND OF SOME OTHER METALS.*

By P. CASAMAJOR.

AT the last meeting of this Society I was to speak to you on amalgamation of iron, but was prevented by the lateness of the hour from reading the paper I had ready for you. Since that evening I have learned a great many things about iron amalgam, one of which is that most of the processes that I was to describe had already been published, although in a very succinct form, about nineteen years ago. This discovery would have prevented me from appearing before you to-night if I had not found that the subject is deemed by chemists, to whom I have shown samples of amalgamated iron, to be not only new, but very interesting. I have, besides, much new matter to communicate, among which is a new process for amalgamating iron, which is so simple and economical that all the other processes are rendered obsolete and useless.

That iron will combine with mercury is known to all chemists, although it is not deemed an easy operation, and we may find in the books several processes for accomplishing the combination. One of these, which I believe is due to Sir Humphry Davy, consists in immersing sodium amalgam in a saturated solution of ferrous chloride or sulphate. In another process zinc amalgam is brought in contact with iron filings, in presence of a solution of ferric chloride. The filings become coated with mercury. In still another process, the electrolysis of ferrous sulphate gives iron amalgam when the negative electrode is formed of mercury. By subjecting the resulting amalgam to enormous pressures a residuum of pretty firm consistency is obtained, which is composed of about equal parts of iron and mercury.

The processes of amalgamation which I am to describe to you this evening give products which have nothing in common with these iron amalgams. The samples of iron amalgam, such as I have here, are obtained from commercial wrought-iron, from cast-iron, and from steel, without altering the original shape of the material, as I am analogous to the amalgam made from commercial zinc which we use in voltaic batteries.

Before giving you the results of my labours I must give you a succinct account of the researches of Cailletet,

* Read before the American Chemical Society, June 21st, 1876. Communicated by the Author.

which came to my knowledge as follows:—Before presenting myself before you at the last regular meeting it had been my endeavour to ascertain whether the results I was to announce were really new. Neither by my own exertions nor by inquiry from other chemists had I been able to discover that I had been forestalled, and had I confined my attention to iron I would not have been aware—perhaps even now—of the existence of a prior claimant.

Having turned my attention to aluminium, I had occasion to consult Watts's "Dictionary of Chemistry," on the subject of aluminium amalgam, and came upon the following:—"According to Cailletet (*Comptes Rendus*, vol. xlv., p. 1250, aluminium (also iron and platinum) may be superficially amalgamated by contact with ammonium or sodium amalgam and water; also when it is immersed in acidulated water in contact with metallic mercury, forming the negative electrode of a voltaic battery."

On consulting the 44th volume of the *Comptes Rendus* I found, at p. 1250, a memoir presented to the Academy of Sciences by Messrs. Chevreul and Dumas, at the sitting of June 15th, 1857, the title of which is "On the Influence of Nascent Hydrogen on Amalgamation," by M. L. Cailletet. The author uses ammonium amalgam, with which he agitates pieces of iron, aluminium, or platinum, and he finds that these metals become coated with mercury. The amalgam of sodium produces the same effect, only water is necessary to the reaction. If the surface of the sodium amalgam is covered with naphtha no action takes place, but one drop of water is sufficient to produce the desired effect.

If in a vessel containing mercury and acidulated water we place the electrodes of a battery, and if the negative electrode be a piece of sheet iron in contact with mercury, the iron will be amalgamated as soon as hydrogen appears on this electrode.

From these experiments Cailletet concludes that amalgamation in these cases is due to nascent hydrogen, and he seems throughout his memoir to be so intent upon proving this point that every other circumstance is mentioned in the most cursory manner. We may be allowed to doubt whether by covering sodium amalgam with naphtha, so that when iron comes in contact with the amalgam it is already covered with a film of naphtha, we have placed the iron in the best condition to combine it with mercury, and whether the non-combination under these circumstances is very conclusive of the necessity of nascent hydrogen to determine the combination between iron and mercury.

The following experiment with a mercuric salt carries more weight with it:—The author wishes to show that amalgamation, in the case of iron and platinum, is due to nascent hydrogen, and not to the electrical condition of the iron or platinum electrode. He takes the case of the electrolysis of salts of copper, silver, and mercury, and recalls that at the negative electrode we obtain metallic copper, silver, and mercury, but no hydrogen. If we have a salt of mercury subjected to a voltaic current, the negative electrode being made of iron or platinum, we may notice after a while that globules of mercury appear on this electrode, but they show no tendency to combine with it. If, now, the electrodes are withdrawn from the mercury salt, and placed in a vessel holding acidulated water, as soon as the voltaic current passes and hydrogen escapes at the negative electrode the globules of mercury spread on this electrode, and it becomes amalgamated.

The above account of the memoir presented by Cailletet contains substantially everything there is in it. The circumstance mentioned in "Watts's Dictionary," that the amalgamation obtained on iron and platinum is merely superficial, does not appear, even by implication, in the original paper.

Amalgam of sodium and ammonium, and the voltaic battery: these are the agents mentioned by Cailletet; these were also the agents that I used a month ago to de-

termine the combination of iron with mercury. Although I now use a much simpler and a cheaper process, which I propose to describe in a few minutes, there are some points in connection with the alkaline amalgams and with the action of the voltaic current which may be studied with advantage.

Amalgam of potassium, which I first used for amalgamating iron, behaves in every way like amalgam of sodium. Sodium, however, behaves somewhat differently from potassium towards mercury, the combination with sodium taking place with greater violence, being accompanied by a flash of sodium light and the escape of alkaline vapours which are far from agreeable. These unpleasant manifestations may be reduced to a minimum by combining sodium at first with a very small quantity of mercury—a quantity not more than a fifth of the weight of the sodium. This gives rise to a violent reaction, but subsequent additions of mercury produce less and less effect, while, by bringing small pieces of sodium successively into a comparatively large mass of mercury, every fresh piece of sodium produces the same effect as its predecessor.

If the sodium amalgam has sodium enough in it to make it pasty, it will cover iron with a silvery coat. This coat may be rubbed off, leaving the oxidised surface unaltered. If brought in contact with water, or, still better, with a solution of sal-ammoniac, the sodium amalgam is decomposed and the mercury will sink into the iron. If the sodium amalgam is liquid it will adhere in little drops all over the surface of a piece of iron shaken up in it; by the action of water, of acids, or of sal-ammoniac, the droplets will spread on the iron, which will become amalgamated.

Ammonium amalgam will give up its mercury to iron when rubbed up with it very persistently. Even then there are in every piece of iron certain spots where the mercury will not adhere. The intervention of acidulated water, by decomposing ammonium amalgam with great energy, facilitates the amalgamation of iron in these difficult portions.

From the foregoing remarks you will understand that the maximum of good effect may be obtained from a certain amount of sodium by the following method of procedure, while the combination of iron with mercury is very thorough and rapid:—We take four porcelain dishes and place them in a row, so that the piece of iron to be amalgamated may be placed successively in each. The first dish contains a liquid sodium amalgam; the second a solution of sal-ammoniac; the third water, acidulated with either sulphuric or hydrochloric acid; and the fourth aqueduct water. The piece of iron to be amalgamated is taken up with tongs, and agitated in contact with the sodium amalgam of the first dish. This operation covers it with liquid mercury containing sodium amalgam. When the surface seems sufficiently coated the iron is left for a few seconds in the solution of sal-ammoniac, on emerging from which it is found covered with the curious and interesting compound which we call ammonium amalgam. The piece of iron is placed next in the acidulated water, and finally in aqueduct water, to wash off the acid.

This series of operations is generally sufficient to leave a good coat of mercury on a piece of iron. If there should be spots left bare, a second series of immersions is generally sufficient to leave the surface perfectly covered. I need not say that the surface of the iron must be previously made clean by immersion in diluted acid.

By making the negative electrode of a voltaic battery of iron, and placing it in contact with mercury and with acidulated water, the iron will, after a time, become amalgamated. I have obtained the same result by a single voltaic element, the positive plate of which is a piece of zinc and the negative plate a piece of iron, one portion of which is in contact with mercury at the bottom of the cup, the exciting fluid being acidulated water. An addition of chloride of sodium to the liquid in the cup seems to hasten the reaction.

Iron may be amalgamated also by the use of zinc amalgam. This process gives the best results, and renders superfluous all the other processes we have mentioned. The use of zinc amalgam for the purpose had been attempted before, as, for instance, in the process I have mentioned where iron filings are rubbed with zinc amalgam in presence of a solution of ferric chloride, the reaction being assisted by heat. I also find in "Watts's Dictionary" that, "according to Aikin, iron amalgam is formed by the action of zinc amalgam on ferrous chloride." No particulars are given about this process, but the results must have been, to say the least, difficult to obtain, as we find, immediately after that, "according to Damour, it cannot be obtained in this way."

I came upon the process I am about to describe by a mere chance. I was trying to test the soundness of the theory of Cailletet, which attributes the amalgamation of iron to the presence of nascent hydrogen. In a beaker glass I had placed mercury, and over it acidulated water, and also a horse-shoe nail of Norway iron, which rested on the mercury. A moderate escape of hydrogen took place from the surface of the iron nail; but after twenty-four hours no trace of amalgamation had appeared, which showed very conclusively that unassisted nascent hydrogen was certainly not sufficient to do the work. Having to amalgamate a small piece of zinc for another experiment, I found that I had no other mercury within my reach than the one on which the nail of Norway iron rested. As I had given up hopes of accomplishing anything by this arrangement, I had no scruple to use the mercury in this beaker glass, and in it I placed my piece of zinc: the result was that the escape of hydrogen from the nail increased very perceptibly, which circumstance induced me to leave the zinc in the mercury. On looking again at the iron nail I found it amalgamated and partly sunk into the mercury.

To amalgamate iron with zinc amalgam, mercury should be placed in a vessel and covered with dilute sulphuric or hydrochloric acid. If, now, a piece of iron is agitated, in contact with the mercury and the acid, no combination will take place; but if pieces of zinc are placed in the mercury, in a few minutes iron placed in the above conditions will become coated with mercury. If after a while the power of the mercury seems to decline, more zinc must be added. The zinc is only attacked when iron, or some other metal more electro-negative than zinc, is brought in contact with the zinc amalgam and the acid, so that the expense in zinc is very slight.

The coat of mercury left on iron by the various agencies I have mentioned is not a superficial layer, for the mercury sinks into the metal, modifying its physical and chemical properties. In the case of pure soft iron it is difficult to notice any decrease of tenacity after amalgamation. With hard-tempered steel, however, the increased brittleness is very marked. In the case both of iron and steel a fresh fracture shows that mercury has penetrated deeply into the metal.

Of the chemical change operated on iron by amalgamation I can call attention to only one point, which is the analogy which exists with the properties of zinc amalgam. When a piece of zinc* has been amalgamated it is not attacked by acids as readily as zinc free from mercury; but if a piece of amalgamated zinc is connected to a piece not amalgamated, the amalgamated zinc becomes the positive plate in a voltaic couple. These properties of amalgamated zinc are found, although in a less degree, in amalgamated iron. Two pieces of sheet iron, presenting exactly the same surface, were placed in diluted sulphuric acid, so that the action of the acid was exactly the same on each. One of these plates was amalgamated, the other not. After prolonging the action for over two hours, it was found that the amalgamated plate had lost two-thirds as much in weight as the other.

If, however, two pieces of iron*—one amalgamated and the other not—are connected by a metallic wire, the amalgamated plate is attacked, and the other plate plays the part of a negative.

In iron amalgam, made in the way I have described, the quantity of mercury in combination is very small. A piece of sheet iron, presenting on both sides a total surface of 3 square inches, was amalgamated and left to soak in mercury for over an hour. The mercury was then wiped off very thoroughly, and the piece of sheet-iron weighed. The increase over the original weight was 13 centigrammes, which showed an absorption of mercury equal to a little over 4 centigrammes per square inch. The increase of weight in this thin sheet of iron was only 3½ per cent. Still in this sheet the fracture was silvery, and globules of mercury stood on the rough edge of the fracture.

For the sake of comparison I treated a piece of sheet zinc, of the same dimensions, in the same manner, leaving it, however, only a few minutes in contact with mercury. After rubbing off the excess of mercury, and weighing, I was surprised to find a loss instead of a gain in weight. This was doubtless due to a certain quantity of zinc being dissolved by the mercury.

I must now, to fulfil the programme offered by the title of this paper, speak to you of the amalgamation of some other metals, by which are meant some of those whose point of fusion is very high, and which have always shown themselves exceedingly adverse to combining with mercury. Those that I have tried are platinum, palladium, aluminium, nickel, and cobalt. Except in the case of aluminium there seems nothing of peculiar interest to notice about their amalgams, after what has been said of iron amalgam. These metals all take mercury very readily by the processes which are effective in the case of iron. Aluminium deserves mention on account of its eccentric behaviour: it seems to take mercury in the same manner as the other metals, but shortly after being taken out and dried it becomes very hot, the mercury seems to boil, and the aluminium remains covered with a chalky crust. On brushing this off, the metal is found beneath without a sign of amalgamation.

In conclusion, I will point out that two inquiries suggest themselves in connection with these amalgams. One relates to the determining cause of these combinations, and the other is whether these amalgams—particularly amalgam of iron—can be applied to useful purposes. To both these questions the answer is, that I have nothing satisfactory to offer, although great many things suggest themselves as plausible. I am sure you will readily excuse me from presenting theories that are merely plausible, as to the cause of these phenomena, and feel equally certain that I need offer no apology to this enlightened auditory for calling their attention to these combinations of mercury with iron and other metals, because these have not yet become of practical utility, although it may be befitting to offer an apology for the manner in which the task has been performed.

ON MEASURING AIR IN MINES.†

By JOSEPH DICKINSON, F.G.S.,

H.M. Inspector of Mines.

(Concluded from p. 27.)

WITH such a wide choice of anemometers, let it not however, be supposed that there is no difficulty in ascertaining the true average velocity of some air currents. It is only when the current is regular that implicit reliance may be placed upon such instruments. In an intermittent current the pulsations are shown plainly enough by either the counterpoised fan-plate of the Dickinson anemometer or the pendant of other similar instruments, and

* This observation relates to impure zinc. Amalgamation makes impure zinc behave towards acids like pure zinc.

* This is more easily noticed with steel than with pure soft iron.
† A Paper read before the Manchester Geological Society.

in reading off the velocity from such the average of the vibrations must be taken. But with the windmill anemometers the altered speeds are more difficult to detect, and they are also accompanied by the serious defect that when the intermittence is great the number of revolutions recorded are so largely in excess as to be practically useless, owing to the momentum which the wheel attains, when the current is quick, carrying it (especially when the wheel is a heavy one) with but slightly lessened speed through the periods when the current is slow.

This exaggeration of the revolutions of wheel anemometers in intermitting currents may be readily proved, either by watching the instrument when blown upon in puffs, or by passing it intermittingly over any given distance in a still atmosphere. It may also be proved by placing the instrument in an intermitting current, when the actual average velocity can be accurately known, as in those cases where the total quantity of air passing is known by having to pass through an air-pump of certain dimensions, and making a certain number of strokes per minute. When furnaces or fans are used as the ventilating power, the intermittence is generally not of much importance, except when air doors are opened and such like, or when firing up the furnace, or if there be some irregularity in the construction or working of the fan. But with a single air-pump, worked with one piston, or if there be two pumps and two pistons, but changing stroke at the same time, the effect upon the anemometer, caused by the intermitting current, is such that the revolutions are enormously increased. The intermittence is even perceptible, and affects the anemometer when there are two pumps, one of which changes stroke when the other is at half stroke, but this greatly lessens the injurious effect, and the current is comparatively steady.

Similarly exaggerated results also occur with the windmill anemometers when they are changed about at short intervals, as is not uncommon, in endeavouring to get an average velocity of the current in the various parts of the space where the observation is being taken. In these instances the momentum attained in the quick part of the current carries the wheel round at a higher velocity than it would have attained in those parts where the current is slow.

Inaccuracy in this latter respect may, however, be avoided by having separate anemometers placed at the same time in each part of the airway space where the velocity varies, and averaging the results. When, however, only one anemometer is used for measuring a current which varies at different parts of the space where the velocity is being taken, the anemometer should either be held for a long time in each part of the space, so as to minimise the effect caused by the momentum of the wheel, or a separate measurement should be made of the respective velocities, and an average taken of the results. But in this way it will have to be assumed that the current continued uniform whilst the respective observations were being taken, which perhaps may not have been the fact.

The space occupied by the operator's body in using any anemometer, especially in small airways, or if the instrument be not properly faced to the current, may also, obviously, render the result inaccurate.

It is also essential in using windmill anemometers to ascertain the proportion existing in each instrument between the number of revolutions and the velocity of the air-current. In M. Combes's treatise, previously named, the whirling machine by which he made experiments to find this correction is described. I had an opportunity of seeing this whirling machine at the instrument maker's (M. Newman, I think) when in Paris, in 1853. It consisted simply of a balanced rod, on one end of which the anemometer was placed, and being held overhead by one hand and twirled round on a spindle by the other hand. By taking a series of observations at different speeds over certain linear distances, in a still atmosphere, and comparing the number of revolutions which the anemometer

recorded with the linear distance which it had travelled, the coefficient numbers for correction were deduced. This form for correction M. Combes put into an equation, namely:—

$$v = a \times n + b$$

n being the number of revolutions indicated by the anemometer, and a and b are two coefficient constant numbers determined by the series of experiments, and v the true velocity of the air. This formula is still used, except that other letters are now more common.

This whirling machine of M. Combes was probably the first of the kind. On seeing it, I saw at once that the principle was good, but that the mode of carrying it into practice might be improved; and having described it to Mr. Casartelli, of Manchester, he constructed an improved machine, which was fixed on the floor, and with a whirling circle of about 25 feet in circumference, that of M. Combes being much smaller. Improving upon this some time afterwards, Mr. John Daglish, then viewer at the Hetton Colliery, in Durham, in conjunction, I think, with Mr. Lindsay Wood, adapted to a machine, on the same principle, a weight by which steady velocity was given, the speeds being varied according to the increased or decreased weight attached at one time. And this is the whirling machine now used by instrument makers for setting the scale on the quadrant of the Dickinson anemometer, and for ascertaining the correction for bringing revolutions into velocities with the windmill anemometers. When, however, a standard anemometer of either kind has been obtained, it may be used for setting and testing other anemometers by, provided that the two be carefully experimented upon together in the same currents of air.

Instead of using the formula for deducing the velocity from the revolutions of windmill anemometers, the correction is now frequently, and indeed more readily, made simply by adding a number, which, by testing, as previously described, is found applicable to the particular instrument at different velocities. Thus, if it requires a current of say 50 feet per minute before the wheel begins to revolve, it would require an addition of that number to ascertain the velocity of the air when the anemometer just begins to move, and so on, varying with the respective velocities and instruments. For making the correction in this way, the numbers to be added are sometimes given in a tabular form, and sometimes in the form of a diagram, from which the number has to be measured by a scale. The correction, as before stated, varies with each anemometer; but with Biram anemometers of like construction, and registering revolutions without any attempted correction in the instrument, the required addition for correction does not vary much, and it would appear that, with instruments so constructed, the correcting number to be added diminishes as the velocity increases, the number being often small when the revolutions exceed 400 per minute. The ratio of correction appearing, generally, like the asymptote of the hyperbola, always approaching, but never meeting.

From these sources of error in the measurement of air currents in mines many mistakes have apparently been made in the amounts of ventilation, and when the result has been used for determining the amount of power utilised by ventilating machines, the percentage has been greatly exaggerated.

For comparative observations of the ventilation made from time to time in a mine, the surest way is to place the same anemometer on the same spot, and under the same circumstances, on each occasion relying upon revolutions and not velocity.

But for ascertaining the actual quantity of air passing in a mine when the current is intermitting—so difficult, indeed almost insurmountable, is the process with an anemometer—that, where open lights are allowed, it seems preferable (although it has been called a barbarous way) to resort to the old rough and ready ways, by the smoke of gunpowder or tobacco, or by the flame of a

candle, as previously described; and where gunpowder, smoking, and open lights are prohibited, a small balloon filled with gas, to float in the air and bound about from roof to floor and side to side, as carried by the air current, is a good substitute.

For steady currents, however, there is nothing so good as an anemometer. The candle cannot be carried with the average of the whole current, and the smoke of powder or tobacco is found to hang where the current is slow, making it at times uncertain what portion of the arrival should be taken as indicating the average.

Similarly erroneous computations of the percentage of power utilised by ventilating machines have likewise been made, when, in intermitting currents, the pressure of air (which is one factor in the calculation) has been taken by the common inverted glass syphon water-gauge. Notwithstanding that in nearly all such gauges the tube is usually contracted at the bend, the water dances up and down so that it is impossible to read off accurately the average distance between the two surfaces.

The want of a compensating water-gauge for measuring the pressure of intermitting currents first presented itself to me in the year 1861, when measuring the amount of power utilised by the Struvé air pumps. On that occasion, finding it impossible to obtain any reliable measure of the average pressure of air by the ordinary water-gauge, my colleagues, Mr. Thomas Evans and the late Mr. John Job Atkinson, and myself, used two ordinary buckets of water, one bucket being placed outside and the other in the return air, the water in each being connected by an india-rubber tube. This method served the purpose, but as the buckets widened towards the top, the area of the surface of water in each was not equal, and consequently the depression of water in one did not correspond exactly with the elevation in the other, which made it requisite to measure the height it rose in one and the depth it fell in the other, and to add the two together in order to obtain the total pressure. A readier mode than the buckets of water, as might be expected, soon occurred to us, and in the same year I had a proper compensating water-gauge, made by Mr. Casarelli, of Manchester, (the one shown to the meeting) by which, no matter how intermitting the current, an accurate measure of the pressure may be readily taken, by having the two limbs for the water so large and the connecting aperture at the bottom so small that the flow of water does not sensibly affect the level during the pulsations. The gauge consists of a brass box, divided by a thin partition into two chambers, with glass front, and with the aperture at the bottom connecting the water in the two chambers regulated by a tap. The full size of the gauge is 6 inches high, 4 inches broad, and 3 inches wide; the 4 inches in breadth being divided by the partition, making the two chambers each 2 by 3 by 6 inches. The tap for regulating the flow of water between the two chambers is worked outside, underneath the bottom of the gauge. At the top of one of the chambers there is an opening 1 inch in area to admit the pressure of air on that side, and at the top of the other chamber there is a brass nozzle for inserting through an augur hole to admit the pressure of air at the other side. There is also a tap on this nozzle for closing when required. At each side of the glass front, and also down the middle of it in front of the partition dividing the two chambers, there are scales graduated into inches and tenths, so that the difference between the level of the water in the two chambers may be accurately seen. Mr. Atkinson soon afterwards had also a gauge of the same kind made for himself, but his had a pipe which came outside for connecting the two chambers at the bottom, instead of a tap regulating the size of a hole in the partition, as in mine. These two compensating water-gauges were probably the first of the kind used in this country; it was afterwards using them in testing some of the ventilating machines in Belgium, we were informed that similar gauges had been previously used by the ingenious mining engineers in that country.

NOTICES OF BOOKS.

Analysts' Annual Note-Book, 1875. Edited by SIDNEY W. RICH. London: Published for the Author.

THIS book, as its title implies, consists of a selection of analytical methods which have appeared during the past year. The name of the author is given in every case, but there is, in most instances at least, nothing to indicate whether the various papers are reprints from scientific journals and from the Transactions of societies, or whether they have been originally communicated to the "Analysts' Annual Note-Book." We cannot help suggesting that in future issues of this note-book the editor would do well to conform to the custom of indicating the source as well as the authorship of his extracts. We must likewise insist on the danger of abridging the descriptions of analytical processes. To take an instance: in *M.M. Champion and Pellet's* method for determining glucose in presence of sugar Mr. Rich tells us to "collect and wash the suboxide (copper) formed, place the filter, still damp, in a capsule, and add dilute hydrochloric acid, which converts the suboxide of copper into sub-chloride. The liquid becomes coloured and the copper passes into the state of bichloride of copper of a greenish yellow colour when it is titrated with chloride of tin." But if we refer to the *Comptes Rendus*, No. 3, Jan. 18, 1875, or, in default, the *CHEMICAL NEWS*, vol. xxxi., p. 84, we shall find that the liquid in question is to be "raised to a boil, adding by degrees some crystals of chlorate of potash," by the action of which the conversion of the sub-chloride of copper into the bichloride is effected. If, as we doubt not, Mr. Rich wishes to render his note-book really useful to analysts, he will agree with us that every step in a novel analytical method should be fully described.

A great part of the matter given relates to the adulteration of food and drugs, and must have already come under the notice of the majority of chemists in this country. The fact that certain impure ammonia turns a "gooseberry red colour" on admixture with nitric acid is not a recent observation. To our certain knowledge it was utilised as a test in dye-works, &c., in the North of England eight years ago.

Seventh Annual Report of the State Board of Health of Massachusetts; January, 1876. Boston: Wright and Potter.

WE have here a most elaborate report on the sanitary condition of the State of Massachusetts. The condition of the rivers, the sources of pollution, the water supply for domestic and manufacturing uses, the sewerage of the towns and villages, and the disposal of the sewage are all fully described.

On the subject of the "Disposal of Sewage" there is a special paper by Dr. C. F. Folsom, in which the past experience of the principal European countries is described. Such a treatise would have been exceedingly useful had the author taken the trouble to ascertain the truth. Instead of so doing he accepts and retails a number of the statements which English sewage irrigationists have repeated till they believe them. As an instance of the glaring errors with which this essay abounds we turn to the account of the sewage treatment at Leeds. We are told that the authorities there tried several of the precipitating processes one after the other, "finding them all failures." This is incorrect; two, if not three, of the processes tried have been found successful, and one of these has been selected as most completely answering all the conditions required of a sewage process. The deposit is not, as Dr. Folsom has been informed, "quite offensive" whilst drying. The tanks are not made of iron, but of masonry; they are not six in number, but twelve; they are not cleaned out when the deposit becomes a foot deep—which is never the case in those farthest from the infall—but *pro re nata*. The effluent when the opera-

tion is fairly worked does not "soon putrefy." The manure, instead of being unable to find a sale at two shillings a ton, is contracted for a twelvemonth in advance at twelve. What confidence can be placed in an author who heaps up inaccuracy upon inaccuracy in such a manner, and what must we think of his informants? One truthful confession, however, somewhat redeems this imaginative description of the Leeds Sewage Works. The author admits the absence of offensive smell. Here he contradicts one of the most preposterous assertions of the Rivers' Pollution Commission that "bad smells are always perceptible." What he admits further negatives another of their baseless statements, that "the process produces no clearer water than what would have resulted if the sewage were allowed to settle by itself." It so happens that this point has been experimentally decided at Leeds. Some years ago, we do not know whether, in consequence of the assertion quoted by Dr. Folsom—a tank at the Old Works was filled with sewage and allowed to settle. The result was not a clear, colourless, inodorous liquid like that attainable by precipitation, but a nuisance which no one could approach without feeling nauseated.

Speaking of Leamington the author declares that "in 1870 the authorities of this town, having proved the precipitation processes to be costly and expensive failures, gave up their tanks and made a contract to deliver their sewage upon Heathcote Farm belonging to the Earl of Warwick." The only processes which we have ever heard of as having been used at Leamington were the "lime" and the "A B C." The latter of these was not tried until *after* the contract had been made with Lord Warwick. Consequently it was a mere interim arrangement and not a "costly and expensive" failure which drove the Leamington authorities to irrigation.

It is not too much to say that every part of Dr. Folsom's treatise teems with errors. His notice of sewage irrigation is as one-sidedly favourable, as his remarks on precipitation processes are unjustly condemnatory. No mention is made of the important results obtained by Mr. Smee, jun., who showed that milk and butter obtained from cows fed on sewage grass became more rapidly offensive than that of cows fed upon normal herbage. No notice is taken of the important evidence of Mr. Markham that irrigation, even with common river water and applied only when necessitated by dry weather, injures the health of the surrounding districts in India. No less has Dr. Folsom left out of account the valuable report of M. Lefeldt, the Prussian commissioner, who complains of the "mephitic odours" on the model sewage farm, and who found the stems of grass from irrigated meadows full of unassimilated sewage matters. Irrigation is doubtless valuable in climates where there is no rain during half the year, but in England where the average supply of moisture is too great for our most valuable crops it is a delusion which it will puzzle posterity to account for.

In short, we must pronounce Dr. Folsom's treatise an utterly untrustworthy compilation, and for the sake of sanitary science in America we regret that it has ever appeared.

The other portions of the volume are of much greater value.

CORRESPONDENCE.

ANALYSES OF MANGANESE OXIDES.

To the Editor of the Chemical News.

SIR,—I notice in the CHEMICAL NEWS (vol. xxxiv., p. 30) that Mr. Alfred Allen has been asking me some more questions with regard to the determination of MnO_2 ,

Mn_2O_3 , &c., which he ought to be able to answer himself. I have already given him a capital reference and regret to find that he cannot, or will not, avail himself of it. But perhaps I had better reply to his questions, though I am afraid that will not help him much.

1. How does Dr. Phipson know that the 6.20 per cent of Mn_2O_3 was not made up of 3.41 MnO_2 and 2.79 MnO ?

Answer.—Because there is no MnO in the sample.

2. If he does not know how, &c.?

Answer.—He does know.

3. What process was employed for the determination of the main quantity of MnO_2 , and would not that amount include the 3.41 per cent assuming the latter to have any existence?

Answer.—No "main quantity" of MnO_2 was determined.

4. If the result of the determination of MnO_2 72.17 per cent represents the *total* quantity of that oxide present, must not the remainder of the Mn necessarily have existed as MnO and not as Mn_2O_3 ?

Answer.—Certainly not (*vide* answer to question 1).

5. If the last question is answered in the affirmative has not Dr. Phipson counted his oxygen twice over?

Answer.—It is not answered in the affirmative.

I am, &c.,

T. L. PHIPSON, Ph.D.

London, July 22, 1876.

PS.—In my last letter the word "discovered" was erroneously inserted for "determined."

PRIZE FOR HARDENING PLASTER CASTS.

To the Editor of the Chemical News.

SIR,—Will you kindly inform me if the German prize for a method of preserving plaster casts has been awarded? The consignments were to have been in by January last, but I have not been able to obtain any information about the matter.—I am, &c.,

D. D. REDMOND.

July 24, 1876.

ORGANISATION AMONG CHEMISTS.

To the Editor of the Chemical News.

SIR,—The formation of an Institute of Professional Chemists has undoubtedly been mooted mainly for the purpose of raising the status of the chemists; but some of the proposed regulations in the scheme put forward by Mr. Pettengill's clients in the CHEMICAL NEWS of the 9th ult., do not by any means appear likely to further this end. For instance, a person would be eligible for membership if he had "practised on his own account in the profession of a consulting or analytical chemist."

This would obviously admit all those quacks who have chosen to dub themselves "Analytical and Consulting Chemists" without the faintest qualification for the work, while at the same time many of the so-called "works chemists" who have had a thoroughly good scientific training with much experience in technological work, would, unless they had advertised themselves as "Analytical and Consulting Chemists," be excluded.

For the purpose of guiding in its action towards the proposed Institute, I am instructed by the Council of the Faraday Club (which consists solely of chemists of this district) to ask publicly of those engaged in forwarding the new scheme:—

1. How are "high" and "low" analysts and quacks in general now in practice to be excluded?

2. How will technology be represented on the Board of the proposed Institute?—I am, &c.,

Pro the Council of
GEORGE E. D.

1b,

Runcorn, July 21, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 25, June 19, 1876.

Cause of the Movements in the Radiometer of Mr. Crookes.—M. Govi.—Fresnel had found, in 1825, that light bodies freely suspended in an ordinary vacuum might perform under the action of light or heat certain movements, which he referred to the thermic currents of the rarefied gas contained in the receiver. These same movements, obtained in a far more perfect vacuum, have been lately ascribed by Mr. Crookes to the impulsive force of the luminous rays. It is little probable that the displacement of a gas the pressure of which is reduced to a few hundredths of a m.m. can impress an appreciable motion on bodies whose mass is always relatively very large. As for the impulsive force of light, it ought to be *nil* if it be true that light and heat are merely vibratory movements of the ether or of the ultimate particles of bodies. It is no more possible for light to drive a body before it than for the sounds of a musical instrument to sweep along a feather or a particle of dust in the direction in which they are propagated. If the impulsive force of light were proved, it would be necessary to renounce the theory of Huyghens; but before doing that we must at least exhaust all possible means of explaining the movements studied by Fresnel and by Mr. Crookes. If the thermic currents of rarefied gases contained in the receiver where the movement is produced do not suffice for the explanation of the facts observed, there is another cause of displacement much more efficacious, but hitherto not taken into account, which may well give the true explanation of the phenomena. This cause is merely the dilation by heat, or the contraction by cold, of the gaseous layers which all bodies retain on their surface, even when placed in an absolute vacuum. The mass of these gaseous strata is far from being insignificant relatively to that of the bodies which retain them, especially when they are in a very fine state of division, like lamp-black, platinum-black, &c.; or if they are endowed with an especial affinity for certain gases, as palladium for hydrogen. If we admit that this is the true explanation of the facts studied by Mr. Crookes, we may construct insensible radiometers by heating the immovable discs of the apparatus during the action of the mercurial pump. So long as we have not removed from the apparatus the source of movement just pointed out, it is needless to have recourse for the explanation of the phenomena to an impulsive force, which would be at variance with all that we know best concerning the nature of light. M. Fizeau gave an account of an experiment which does not seem favourable to the explanation given by Govi. If a series of equidistant candles are placed around a radiometer, forming a circle of about 50 centimetres in diameter, in the centre of which is the instrument, it is equally and symmetrically illuminated all around its axis of rotation, so that the discs whilst turning receive constantly the same quantity of light as well on their blackened as on their polished surfaces. The rotatory movement being established, under these conditions, with a speed of about ten revolutions in seven seconds, the number of rotations was carefully taken in each successive five minutes. The speed was found constant, and did not slacken during an entire hour. In these conditions would not the speed of the rotation diminish and cease at the expiration of a very short time if it was really produced by the liberation of condensed gases or vapours from the blackened surfaces? We cannot from the uniformity of the illumination admit the supposed alternations of condensation and emissions necessary for the continued maintenance of the movement.

Existence of Mercury in the Cevennes.—M. Leymerie.—The author confirms the existence of mercury in

the Department of l'Herault, as pointed out by N. Thomas (*Comptes Rendus*, May 8).

Influence of Temperature upon Magnetisation.—M. J. M. Gauguain.—Not adapted for abstraction.

Extension of the Principle of Carnot to the Theory of Electrical Phenomena: General Differential Equations of Equilibrium and of the Movement of any Reversible Electric System whatsoever.—M. G. Lippmann.—A mathematical paper, incapable of useful abstraction.

Differential Actinometer.—M. N. Egoroff.—The author describes his apparatus, with which he hopes to determine the coefficients of absorption of the ultra-violet rays.

Researches on the Commercial Analysis of Raw Sugars.—A. Riche and Ch. Bardy.—The chief novelty in the authors' method is that they take a sample five times larger than usual, and operate upon one-fifth of the solution, in order thus to obtain a fairly representative sample. They also employ a modification of the ordinary polarimetric tube.

New Class of Colouring Matters.—M. Ch. Lauth.—Reserved for insertion in full.

Certain Derivatives of Isoxylene.—M. Ch. Gundelach.—This paper contains an account of the chloride of isotolyl and of isotoluic aldehyd.

The Nickel Ore of New Caledonia, or Garnierite.—M. J. Garnier.—The nickel ores of New Caledonia are not arsenio-sulphides like those hitherto utilised, but silicates of nickel and magnesia. The ore is found amidst the masses of serpentine very abundant in certain parts of the island, and associated with euphotides, diorites, amphibolites, &c. The nickel is accompanied by iron, chrome, and cobalt; these metals, especially the two former, are of an unexampled abundance. The cobalt is associated with manganese.

On Nitro-Alizarin.—M. A. Rosenstiehl.—The author demanded the opening of a sealed paper deposited by him on March 13, 1876, and containing an account of the new compound. Madder-red exposed to nitrous vapours becomes orange, and the shade thus produced is only rendered more brilliant by washing and by boiling soap-lyes. Turkey-red undergoes the same change, the resulting colour being quite as solid as that from which it is derived, and of a tone and a brightness which could hitherto only be produced on printed goods by means of chromate of lead. The orange obtained by the action of nitrous vapours is so much the brighter, as the madder-red contains less purpurin. The colour can scarcely be withdrawn from the fibre upon which it is deposited without attacking the latter. The small quantity obtained dyed an orange shade with mordants of alumina. Nitrous vapour brought in contact with alizarin in solution, or suspended in water, acetic acid, alcohol, sulphuric acid, &c., produced compounds of a yellow colour, but devoid of tinctorial power. This result agrees with that of Ntenhaus, who found that alizarin was reduced by nitrous acid to anthraquinon under circumstances very analogous. Fuming nitric acid employed alone, or mixed with sulphuric acid, did not give a satisfactory result. The author then prepared the new colour by pouring the commercial alizarin paste into large glass flasks, coating the interior therewith by means of agitation, draining, and drying, thus leaving the flasks lined with a layer of finely divided alizarin. They were then filled with nitrous vapours and stoppered, when in a few minutes the colour of the alizarin was changed, and the gas decolourised. Two colouring matters were formed, one of which, probably unchanged alizarin, gave a red with aluminous mordants, whilst the new substance dyed an orange. The new colour is composed of—

Carbon	58.94
Hydrogen	2.45
Nitrogen	4.91

answering to the formula $C_{14}H_7(NO_2)_4O_4$. By the reduction of nitralizarin the author has obtained two products, which are formed successively: the one dissolves in alkalies with a blue colour, and dyes a garnet with aluminous mordants; the other dissolves in alkalies with a brown colour, and dyes a catechu colour with alumina.

Bulletin de la Societe Chimique de Paris,
No. 1, July 5, 1876.

On Benzylic Naphthalin.—M. Pierre Miguel.—Not suitable for abstraction.

Metallurgy of Silver in the Moist Way.—M. Antony Guyard (Hugo Tamm).—This paper is devoted to the treatment of the sulpho-antimoniuiretted ores of Bolivia, known as *Rossicler*,—very rich, but so difficult to treat in the dry way that many smelters refuse to work them. They may, however, be very advantageously treated in the moist way, the sole condition of success being the use of a quantity of acid sufficient to oxidise the sulphur and all the metals. The following analyses show the general composition of these ores:—

	1.	2.	3.
Sulphur	18.35	16.20	17.85
Silver	48.15	46.10	38.10
Antimony	10.85	7.10	28.35
Iron	5.60	7.70	0.95
Zinc	4.50	4.10	5.25
Bismuth	2.20	—	—
Lead	traces	traces	1.50
Arsenic	0.15	0.10	0.25
Copper	—	—	0.25
Chlorine	—	0.15	—
Gangue	10.20	18.55	7.50
	100.00	100.00	100.00

Analysis of the Peroxide of Manganese.—Dr. T. L. Phipson.—Already noticed.

Memoir on the Determination of Nitrates.—M. Ferd. Jean.—For the analysis of commercial samples of nitre the author recommends the following procedure:—Into a small glass flask, holding about 200 c.c., introduce a concentrated and very acid solution of ferrous chloride. The flask is closed with an india-rubber stopper pierced with a hole, through which pass a delivery tube under a leaden shelf in a tank of water lined with lead, and a very short tube, to which is fixed a small funnel by means of a flexible caoutchouc tube, the communication with the flask being intercepted by means of a Mohr's spring-clip or a small glass tap. The trough being filled with water, the ferrous chloride is raised to a boil, and, as soon as the sound made by the condensation of the acid on the water of the trough announces that a vacuum has been made in the flask, a gas-jar filled with water is placed over the opening in the shelf. The jar should be of the capacity of 200 c.c., graduated in tenths. Then we pour into the funnel 5 c.c. of a solution of nitrate of soda, formed by dissolving in a litre of 66 grms. of pure nitrate of soda recently melted at a low temperature. The solution of ferrous chloride being kept at a boil, the solution of nitre is allowed to enter the flask drop by drop, taking care not to empty the funnel completely: 2 to 3 c.c. of distilled water are then placed in the funnel and allowed to enter the funnel, and finally the funnel and the tube are rinsed with 5 to 10 c.c. of fuming hydrochloric acid. The binoxide of nitrogen produced by the decomposition of the nitrate of soda enters the graduated jar, and as soon as the sound announcing the presence of a vacuum in the flask is heard the graduated jar is withdrawn and allowed to stand on a support in the trough. This first operation makes known the volume of gas obtained from a known weight of nitre, without it being needful to take account of the corrections for temperature, pressure, &c. Into the flask are then introduced 5 c.c. of a solution of the nitre in question in 100 c.c. of distilled water, and the

salt is decomposed. This solution is made by dissolving 6.6 grms. in the same manner as the foregoing, and the binoxide of nitrogen is collected in a second graduated jar. The two jars are kept till they have acquired the same temperature and the respective volumes of gas produced are read off, care being taken to keep them immersed so that the water may stand at the same level within and without. The volume of gas produced by a given weight being thus known, the proportion of real nitre existing in the sample under examination is readily calculated.

(In a subsequent part of the paper the author speaks of the determination of nitrogen by the "procede Winckling." On careful examination this proves to be a Gallicised version of the name of Mr. Wanklyn.)

On Isobutylenic Chlorhydrine, and on the Law of the Addition of Hypochlorous Acid.—M. L. Henry.—Already noticed.

On the Law of Dulong and Petit.—M. A. Terreil.—Already noticed.

On Erythrophlæum Guineense and coumunga.—MM. N. Gallois and E. Hardy.—A chemico-pharmaceutical paper, not adapted for abstraction.

On Certain Derivatives of Isoxylene.—M. Ch. Gundelach.—Already noticed.

Justus Liebig's Annalen der Chemie,
Band 181, Heft 3.

Combination of the Elements of the Nitrogen Group with the Radicals of the Aromatic Series: Section I.; on Aromatic Phosphorus Compounds.—A. Michaelis.—A treatise extending to one hundred pages, and utterly incapable of useful abstraction.

On Ammonium Compounds.—W. Lossen.—Likewise not adapted for abstraction.

On Benzhydroxamic-ethylester.—Dr. Martin E. Waldstein.—The author describes the properties of this compound, to which he assigns the formula—



and its silver salt, and then discusses its constitution, with those of ethyl-benz-hydroxamic acid, benz-hydroxamic acid, and the benz-hydroxamates; the decomposition of benz-hydroxamic-ethylester by hydrochloric acid, and its methyl compound.

Occurrence of Arsenic in Ancient Bronzes.—H. Spirgatis.—The author has found arsenic in old Prussian bronzes to the extent of 3.52 per cent.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of chlorine. H. Deacon, Appleton House, Widnes, Lancaster. March 11, 1875.—No. 906. This invention consists in using a mixture of common salt or other similar chloride with a compound or salt of copper, or with other so-called chemically active salt, such as is now employed in what is known as Deacon's process for making chlorine from hydrochloric acid gas and air, previously mixed and heated in combination with a separate source of hydrochloric acid gas, which may be from the well-known manufacture of sulphate of soda by reacting on common salt with sulphuric acid, or otherwise obtained. The common salt used in carrying out this invention may be in grains, which may either be moistened with a solution of the so-called chemically active salt or salts, which may, for example, be sulphate of copper; or the common salt and sulphate of copper may be in solution, and this solution may be used to impregnate pieces of burnt clay or other porous materials therewith, the mixture or impregnated material being subsequently dried. Or salt mixed with copper ore—such, for example, as the sulphurets or the oxides—or with other natural or artificially produced insoluble compounds of copper, may, in a fine state of division, be employed in lieu thereof, or in conjunction with the soluble salts of copper before referred to. The apparatus, in which the mixtures as described may be used in combination with a separate source of hydrochloric acid, may be a column or tower, or a number of columns or towers connected together, and made of iron or brickwork or both, as more fully described in the Specification of a Patent granted to me on September 13, 1870, No. 2469. During the manufacture of chlorine by this in-

vention, chloride of copper is volatilised; and it is by this invention obtained in a dry state from the gases issuing from the apparatus by passing them through a suitable column or tower made of stone or other suitable material, and partly filled with pieces of burnt clay or other similar material, the whole arrangement acting as a "scrubber" of the gases, and being kept at any temperature between that at which aqueous hydrochloric acid gas condenses, and that at which chloride of copper sublimates, say about between 300° and 600° F. The chloride of copper condenses in this apparatus in a state much like wool, and may be removed from time to time, and utilised; and this method of separating chloride of copper from gases containing it may be employed whenever these gases containing it are obtained in the manufacture of chlorine by any other process than the process described herein.

Improvements in apparatus for ventilating mines. W. Knott, Wigan, and T. Rudd, Blackrod, near Wigan, Lancashire. March 12, 1875.—No. 916. Our invention consists in placing the wings of ventilating fans at an angle to the axis instead of parallel thereto as now usual; also in making the casing of such fans of cast- or wrought-iron instead of brickwork; also in varying the discharge orifice by means of a pair of plates hinged together, and moved to and fro in the flue; also in the use of one or more stationary plates that are put into the flue at various distances from the sides to reduce the discharge orifice; also in driving the said fans by means of steam-engines set diagonally on the frame supporting the fan-shaft.

Improvements in apparatus for the evaporation or concentration of fluids at high or low temperatures with or without the application of a current of air or steam. W. Morgan-Brown, Southampton Buildings, London. (A communication from G. A. Hagemann, Copenhagen.) March 16, 1875.—No. 965. This invention consists in evaporating fluids by letting them trickle down vertical or conical tubes, the outer part of such tubes being heated by steam or fire, and in some cases currents of air, cold or warm, are passed up the interior of the tubes in the contrary direction to falling fluid to assist the evaporation by removing the vapour or adding to the heat of the liquid being evaporated.

Improvements in the treatment of sugar-cane for the manufacture of sugar and of paper-pulp, and in the machinery or apparatus employed therein. J. H. Johnson, Lincoln's Inn Fields, Middlesex. (A communication from J. B. J. Mignon and S. H. Rouart, both of Paris.) March 16, 1875.—No. 973. This invention has for its object treating sugar-cane in such a manner as to render the extraction of the juice more complete, in order to obtain an increased yield of sugar, which result has also the effect of bringing the cane-trash into a better condition for the manufacture of paper, for which purpose it may be utilised. According to this invention it is proposed to split the cane in the direction of its length before it is subjected to the actual or final crushing operation.

Improvements in the manufacture of sulphate of soda or potash and bleaching-powder, and in apparatus employed therein. G. D. Mease, Lake Chemical Works, South Shields. March 16, 1875.—No. 977. This Provisional Specification relates to the manufacture of sulphates by the direct action of sulphurous acid, air, and steam upon chlorides of sodium and potassium. Also the processes for producing chlorine and for preparing lime for the manufacture of bleaching-powder.

Improvements in the manufacture of soap. S. S. Lewis, Southampton Buildings, London, and A. Copie, Bolsover Street, Middlesex. March 17, 1875.—No. 988. The said invention relates to the mode and means for improving the qualities and decreasing the cost of hard, soft, and toilet soaps. We dissolve ordinary soap, and mix with the solution china clay or other ingredient. We use this compound as a vehicle or body to hold the chemicals: we also add to the compound a portion of *potasse de savon de palm*. We add perfume when the compound is cooling for the toilet soap in the usual manner. The detergent or cleansing property of this soap is the silicate of soda.

Improvements in forming the hearth of puddling-furnaces. W. Inns, Stockton-on-Tees, Durham. March 18, 1875.—No. 1005. According to my invention I take "best tap" in the liquid state direct from the cinder bottom furnace, and before it becomes cool cover with a layer of the same of suitable thickness the cast-iron plates of the hearth of the puddling furnace.

Improvements in the manufacture of colouring-matter suitable for dyeing and printing. T. Holliday, Huddersfield, York. March 20, 1875.—No. 1031. Chlorinated or brominated anthracinon, obtained as described in the Specification of Letters Patent granted to Charles Liebermann and Charles Graebe, dated December 18, 1868, No. 3850, or otherwise, is heated with strong sulphuric acid until the compound obtained is soluble in water. This product is then diluted with water, and the excess of acid it contains neutralised with an alkali or an alkaline carbonate. The clear liquid obtained is then concentrated and heated with caustic alkali, as is now well understood, until the colour is developed.

Improvements in the manufacture of colouring matters. F. Versmann, Ph.D., Brecknock Crescent, Camden Town, Middlesex. March 20, 1875.—No. 1038. This Provisional Specification describes the separation of the yellow dye, known as chrysotoluidin or phosphine, from rosanilin, or from any by-product, residue, or refuse resulting from the manufacture of rosanilin, by means of bisulphide of carbon or petroleum.

Improvements in converting glassy slag resulting from metallurgical operations for the utilisation thereof. F. W. Da'ne, Swansea, Glamorgan. March 22, 1875.—No. 1052. This invention mainly consists in converting the glassy slag resulting from iron blast-furnaces and other metallurgical operations into a stony or basaltic mass, and also casting said slag into any shape required. The slag is cast into hot moulds, which are heated and kept at a high temperature, and then allowed to cool for about twenty-four hours. Arrangements for carrying out this invention are described in the Specification.

Certain improvements in the construction of filters for the purifica-

tion of water and other liquids. H. Rawlings, Stamford Street, Lambeth. March 23, 1875.—No. 1053. The nature of this invention is to provide a means of controlling the currents of liquids passing through any filtering medium and substance by mechanical arrangements and dispositions in the filtering vessels to attain this result, and to construct portable and table filters on an improved plan, that storage of filtered waters may be unnecessary. Also to provide a ready means of regulating the flow of water through filters in the total quantity of liquid delivered, and for entirely stopping the flow if required.

Improvements in the treatment of slag or scoria, and of iron. J. J. Bodmer, The Grove, Hammersmith, and L. R. Bodmer, Lansdowne Road, Notting Hill, Middlesex. March 23, 1875.—1054. Our invention consists, first, in disintegrating or granulating the scoria or slag from blast-furnaces and other furnaces by means of jets of water directed or projected against the flow or a stream of slag on its issuing from the furnace or runner. Secondly: in disintegrating or granulating iron in its liquid condition as its flow from the furnace or runner by jets of water, and also in disintegrating, granulating, and partly fining the iron by using jets of steam either alone or together with jets of water, the disintegrated iron falling into water.

Improvements in the manufacture of glucose-sugar, and in obtaining infusions and extracts for brewing and other purposes. J. N. Lessware, Bow, Middlesex. March 24, 1875.—No. 1083. The invention consists, first, in causing the materials to circulate continuously through the converter, whereby the process of converting them into glucose or grape-sugar is accelerated, the same process being also applicable for obtaining infusions and extracts for brewing and other purposes. Secondly: in decolourising the liquor by means of sulphurous acid gas in its passage from the converter to the neutraliser.

An improved method of and apparatus for carbonising coal, slack, peat, wood, bones, and other like materials, subjected to a cooking process, or to destructive distillation, whereby commercial products are obtained, and the vapours or gases utilised. J. Nicholas, Hope, near Mold, Flint. March 27, 1875.—No. 1116. The features of novelty which constitute this invention consist in constructing an apparatus, being a chamber, oven, or vessel of fire-brick or iron with a range of fire-bars at the bottom, so arranged that they can be dropped to allow the contents of the chamber to fall out. On the top of the chamber there are apertures, and to one of these there is connected a pipe which leads to a condenser. The condenser is connected to a purifier which is connected to an exhausting force-pump. This pump propels the incondensable gases to where they are to be stored or utilised. Attached to the condenser is a pump to free it from the condensed products.

Improvements in purifying raw or partly refined sugar. R. F. Smith, Greenock, Renfrew, North Britain. March 29, 1875.—No. 1136. The feature of novelty which constitutes this invention is the use of steam, conjoined with a vacuum, for the purification or partial purification of raw or partly refined sugar in the manner described, or any mere modification thereof.

Improvements in machinery or apparatus for the manufacture of pulp for paper. De'Angelis Rocco, Rome, Italy. March 31, 1875.—No. 1155. The wood from which the pulp is to be made is first cut into very small pieces by means of a revolving cylinder provided with a very large number of steel knives, under which is drawn a carriage on which the wood is fixed. The wood thus prepared (or straw or rags may be employed) is then placed in a cylindrical wooden vessel containing water, and provided with a mixing wheel. Sulphurous acid gas is introduced into this vessel, and the substances under operation are converted into a colourless pulp, which is then conveyed to a hopper, from which it passes on to an endless cloth, and thence between a revolving granite cylinder and concave granite bed. A tube then conveys it to a drum provided with three receivers, and the pulp which has become reduced to the requisite degree of fineness passes through a metallic wire gauze into a box beneath. The pulp not sufficiently reduced passes out of the drum, and is carried back by a chain-pump to the hopper, to be again passed under the granite cylinder.

NOTES AND QUERIES.

Decomposing Furnace.—In reading over the discussion on Jones and Walsh's decomposing furnace (CHEMICAL NEWS, vol. xxiv., p. 28) I see the percentage of sulphate put down from a calculation made during the discussion at 114. Should it not from the data given be rather more, viz., 117.85.—A PRIVATE STUDENT.

THE LATE SIR CHARLES WHEATSTONE, F.R.S.

The Physical Society of London, with the concurrence and co-operation of the Representatives of the late Sir Charles Wheatstone, are preparing to issue a collected edition of his published and unpublished scientific papers. Separate copies of several of the former being wanted for the use of the printers, the undersigned will be glad to receive offers of them on loan or for sale.
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METHODS OF CHEMICAL DECOMPOSITION AS ILLUSTRATED BY WATER.*

By Prof. J. H. GLADSTONE, Ph.D., F.R.S.

AMONG the most venerable of the Chinese classics is the "Shoo King," a collection of ancient historical records; and one of these records, the fourth book of Chow, contains a still more ancient document "The Great Plan with its Nine Divisions," which purports to date from the early part of the Han dynasty—according to Dr. Legge, about 2000 B.C. This remarkable treatise bears on physical as well as ethical philosophy, and commences with an account of the five elements, viz., water, fire, wood, metal, and earth. The first element, water, is said to "soak and descend," and also to "become salt."

This seems to be the earliest known record of that doctrine of elements which spread widely over the ancient world. In the "Institutes of Manu," we read of the elements also as five, but they are earth, fire, water, air, and ether; and according to the cosmogony of the Hindoo legislator, light or fire produced water, and water produced earth. There was, however, at least as late as two centuries ago, a sect in India who held it as a religious tenet that water was the prime and original element.

Similar opinions found their way to Europe. Thus Thales, of Miletus, who flourished in the sixth century B.C., taught that water was the origin of all things. The Greek philosophers generally adopted the theory of several elements, but reduced the number to four—fire, air, earth, and water.

It is hard to say what was the precise meaning attached by the ancients to the term "element." It no doubt did not always convey the same idea. Water also, at least in the Aristotelian philosophy, was a generic expression for many bodies in a fluid condition, and signified not so much a special material substance as an inherent quality of things. Thus it was said to be cold and moist, and the opposite of fire which was hot and dry. In the philosophy of the middle ages we find the same views prevailing, and the early chemists still looked upon water in the same light. Thus Becker enumerated five elements—air, water, and inflammable, mercurial, and infusible earth; while Stahl adopted four—water, acid, earth, and phlogiston. The ancient theory maintained its hold till the experimental philosophers at the latter part of the eighteenth century gave a definite meaning to the term element, and showed that water, air, and earth are compound bodies. Yet the idea of the elementary character of water was not easily abandoned.

In 1781 Cavendish found that when a mixture of what were then called "inflammable air" and "dephlogisticated air" is exploded by a spark in such proportions that the burnt air is almost entirely phlogisticated, pure water condenses on the sides of the vessel, and is equal in weight to the weight of the two airs. His theory was that water consists of "dephlogisticated air united to phlogiston," and that "inflammable air is water united to phlogiston." At the time of explosion, according to him, the excess of phlogiston was transferred from the inflammable to the phlogisticated air, and thus both airs "turned into water." Cavendish also explained Priestley's production of inflammable air on heating iron filings strongly, by contending that the phlogiston of iron united with the moisture from which they had not been freed. Lavoisier gave a different explanation of these

phenomena. He held that "dephlogisticated air" is an elementary substance—oxygen—united with imponderable caloric, and that "inflammable" air, or hydrogen, is capable of taking the oxygen from the caloric, thus producing water and heat. "Water is not a simple substance, but is composed, weight for weight, of inflammable and vital air." Thus water was at length deposed from its rank as an element.

In the first year of this century, when the news of Volta's great discovery of the pile was made known in England, Messrs. Nicholson and Carlisle made various experiments with a series of halfcrowns, zinc plates, and pasteboard soaked in salt. Knowing that water conducted electricity, they inserted brass wires through corks at the two ends of a tube filled with water, which they are careful to tell us came from the New River. They were surprised to see a stream of minute bubbles rising from one pole while the other was corroded, and that this decomposition took place at each pole, though they were nearly 2 inches apart. They enlarged the distance, and found that 36 inches of water was too much for their force to traverse. Substituting flattened platinum for their brass wires, they found that the water was decomposed with the production of hydrogen at one end and oxygen at the other.

The old notion that water, by continuous boiling, was turned into stone had been previously dispelled by Lavoisier, but Davy found that some salts and earths remained behind when water was electrolysed, and that when the experiment was conducted in two cells communicating with one another, the liquid in the one cell became acid and the other alkaline. He traced the origin of this in a masterly research, which formed the Bakerian lecture for 1806.* He found that the earthly substances were original impurities in the water, or came from the vessels employed; and using gold cones filled with distilled water and united together by asbestos, he convinced himself that nitric acid was produced at the positive pole and ammonia at the negative. Suspecting that these were produced from the small quantities of nitrogen dissolved in the water combining with the liberated oxygen and hydrogen respectively, he took extraordinary precautions. Making use of water which he had carefully distilled in a silver still at 140° F., and performing the experiment *in vacuo*, or rather in a space which he had twice filled with hydrogen and exhausted as thoroughly as the means at his disposal would permit, he then found that the water was decomposed without the least production of either acid or alkali. "It seems evident then," wrote Davy, "that water, chemically pure, is decomposed by electricity into gaseous matter alone, into oxygen and hydrogen."

In the following year Davy discovered the metals of the alkaline earths, potassium and sodium, and found that when these bodies are thrown upon water they decompose it, appropriating its oxygen and setting free its hydrogen. This is due to the superior chemical power or "affinity" of the alkaline metals.

In 1846 Mr., now Sir William, Grove observed that when steam was subjected to something like a white heat, small quantities of mixed oxygen and hydrogen gas were always produced.† It has since been shown that the gases are actually dissociated in one part of the flame of the oxy-hydrogen blowpipe, after their first combination.

It thus appears that there are three distinct ways in which water may be decomposed:—By an electric current;‡ by some substance which has a superior attraction for one of its elements; or by heat alone.

It will readily be understood that the power of any one of these agents will be augmented by the co-operation of

* *Phil. Trans.*, 1807, p. 1.

† *Ibid.*, 1847, p. 1.

‡ Though voltaic electricity alone is referred to in this discourse, it is well known that other forms of the same agent will effect chemical decompositions. Thus Prof. Andrews has resolved pure water into its constituent gases by frictional electricity, and by that from the atmosphere.

* A lecture delivered at the Royal Institution of Great Britain, Friday, May 5, 1876.

either of the others. Thus, the action of chemical affinity is usually augmented by heat; for instance, if a pellet of sodium be thrown upon cold water it melts, on account of the chemical action at once set up, but if upon boiling water it not only melts but bursts into flame through the greater violence of the action. This is the reason why, in Priestley's experiment, iron at a red heat decomposed team, though it will not do so at ordinary temperatures.

Similarly the electrolysis of water is much facilitated if there is some chemical affinity between the oxygen and the metallic conductors. It is generally said that it requires two cells to decompose water electrolytically. Now, it is true that if platinum poles are employed there is no visible disengagement of gas when one cell only is used; but with zinc poles a single cell of Bunsen or Grove is amply sufficient. Zinc alone without the voltaic current is incapable of displacing the hydrogen in water; but it must be borne in mind that the tendency to combine with oxygen is a constant property of this metal, and is easily brought into activity by the co-operation of the feeble voltaic current. The increased effect upon electrolysis which is due to the nature of the poles is in proportion to the electromotive force of the different metals. For pure water the order is—zinc, lead, iron, copper, silver, platinum, as tested by a galvanometer. This difference of result according to the nature of the metals employed in the electrolytic cell appears generally to have been overlooked, and it is the feeblest metal—platinum—which is usually employed for experimental purposes, doubtless because it is incapable of oxidation—the very reason of its feebleness.

When the other metals of the above list are used, not only does the positive pole oxidise, but the oxide, or rather hydrate, dissolves more or less in the pure water, and becomes itself an electrolyte. The consequence of this is that the positive electrode gradually wears away, while the metal is transferred to the negative electrode, and is deposited upon it in crystalline fringes or filaments. With silver these are particularly beautiful, as they assume arborescent forms, especially when able to spread over the surface of the containing vessel.

The temperature also of the liquid subjected to electrolysis has a great influence upon the result. Thus in an experiment where zinc poles and pure water were employed, the deflection of a galvanometer was found to increase about fourfold between 5° C. and 80° C., and the action augmented nearly *pari passu* with the temperature.

A similar result occurs, as might be expected, when two dissimilar metals, such as zinc and copper, are placed in cold water in connection with one another, and the water is heated. The deflection was found to double between about 30° and 80° C., but the difference for every 5° at the higher temperatures was several times greater than at the lower ones.

Another very important point in the electrolysis of water is to reduce to a minimum the very great resistance offered by the water itself. This is effected by bringing the electrodes as near to one another as possible; and for the same reason, if the force be generated by the action of two dissimilar metals upon water, they should be brought into the closest proximity.

A still more powerful means of decomposing water would evidently be a combination, not of two, but of all three agents, chemical affinity, heat, and voltaic force acting at an insensible distance. Thus zinc has a strong affinity for oxygen, but is unable of itself to displace the hydrogen of water; when united, however, with a more negative metal, such as copper, its power is enhanced to such a degree that a separation of the constituents does take place; but in the ordinary arrangement of a voltaic cell the action is so slight that no evolution of gas is perceptible. To produce a visible effect, the metals must not only be close together, but ought to touch one another at a myriad of points. This may be brought about by de-

positing the copper upon the zinc in a spongy condition; then the zinc will be oxidised, and bubbles of hydrogen will appear among the branches of the copper, even at the ordinary temperature, but the effect is greatly increased by the application of heat.

The arrangement just described is the "copper zinc couple," which has been employed by Mr. Tribe and the speaker, and more recently by others, to effect a variety of chemical decompositions. Zinc foil is immersed in a solution of sulphate of copper until a black velvety deposit of the metal is produced: the soluble salts are then washed away, and the couple after being dried is ready to be placed in any liquid it is desired to decompose. Water was the first body experimented upon, and it was found that the action would go on as long as there was any metallic zinc left in union with the copper, the amount of hydrogen evolved gradually diminishing, though varying somewhat with the temperature of the day. The great influence exerted by heat is, however, better shown in the subjoined table, which gives the results of an experiment reduced to the unit of an hour's work.

At 22° C.	.. ..	1.1 c.c. of hydrogen produced.
22°2	.. ..	5'5
34'4	.. ..	13'9
55°0	.. ..	62'0
74'4	.. ..	174'6
93°0	.. ..	528'0

These figures strikingly exhibit the rapid acceleration of the action at the higher temperatures.

A greater effect may be produced by substituting for the copper a still more negative metal. Thus a zinc platinum couple acts with much greater energy upon water. Gold zinc couples, and many others also, have been tried, but gold has the practical disadvantage that the precipitated metal does not adhere well to the zinc. Aluminium alone does not decompose water, not even, according to Deville, at a red heat; but an aluminium copper couple decomposes it slowly, and an aluminium platinum couple more rapidly, even in the cold. One of the most recent discoveries is that aluminium when amalgamated with mercury is converted into hydrate, even by the moisture of the air. The most powerful combination, however, might be expected to be that of the most positive and the most negative metal which can be conveniently brought together. These are magnesium and platinum; and in fact, if strips of magnesium foil be coated with finely-divided platinum by immersing them in platinic chloride, and the resulting salts be washed away, a couple may be obtained which produces a most vigorous evolution of hydrogen when it is placed even in cold water.*

The decomposition of water by the copper zinc couple was of course a matter of little practical importance; it does, however, yield hydrogen in a state of purity, even though the zinc be largely contaminated with such a substance as arsenic—a fact which may prove of great consequence in medico-legal inquiries. These observations on water led to a long series of experiments on other bodies, especially organic compounds. The action of the two metals in conjunction frequently effects not only the splitting up of a compound, but a re-distribution of its elements; and this has resulted not only in the discovery of a simple means of producing various substances previously known, but the formation of several others hitherto unknown. Thus the first trials were made on iodide of ethyl in the hope that Prof. Frankland's beautiful process for making zinc ethyl might be simplified; and not only was a better result obtained in a shorter time, but when the experiment was performed in the presence of alcohol it was found that pure hydride of ethyl was given off, and

* Phenomena resulting from different metals in combination have frequently been observed by several experimenters, and some of them are described by Mr. W. N. Hartley in the CHEMICAL NEWS (vol. xiv., p. 73); but it does not appear that the metals have ever been freed from concomitant salts, or their action understood or appreciated.

a new substance, the iodoethylate of zinc, remained in the flask.

Among the bodies which may be prepared more easily or in greater purity by the copper zinc couple are the following:—

Hydrogen.	Olefiant gas.	Diallyl.
Methyl hydride.	Acetylen.	Zinc ethiodide.
Ethyl hydride.	Propylen.	Zinc ethyl.
Pethyl hydride.	Diamyl.	Zinc amyl.
Amyl hydride.		

The substances that have been discovered by this agency are the following:—

Zinc propiodide	$\text{Zn}(\text{C}_3\text{H}_7)\text{I}$.
„ propyl	$\text{Zn}(\text{C}_3\text{H}_7)_2$.
„ isopropyl	$\text{Zn}(\text{C}_3\text{H}_7)_2$.
„ ethylbromide	$\text{Zn}(\text{C}_2\text{H}_5)\text{Br}$.
„ iodoethylate	$\text{Zn}(\text{C}_2\text{H}_5\text{O})\text{I}$.
„ bromethylate	$\text{Zn}(\text{C}_2\text{H}_5\text{O})\text{Br}$.
„ chlorethylate	$\text{Zn}(\text{C}_2\text{H}_5\text{O})\text{Cl}$.

Zinc propyl is a volatile liquid body, of sp. gr. 1.098, which takes fire spontaneously in the air, burning with a bluish white flame. The haloid ethylates are a new class of bodies which have been prepared from both ethyl iodide and iodoform, and their corresponding bromine and chlorine compounds.

The couple has also thrown some light upon the chemical structure of some of these organic bodies, as, for instance, by its different behaviour with the two isomeric bodies, chloride of ethylen and chloride of ethylin. This is a direction in which future investigation is likely to be rewarded.*

This method of quietly bringing about a chemical change has found a practical application in the hands of Prof. Thorpe for determining the amount of nitrates in samples of water—a question of great importance, which has hitherto been also one of great difficulty. The nitric acid is reduced by the couple to the condition of ammonia. In a similar way chlorates are reduced to chlorides.†

The progress of research by means of the copper zinc couple was interrupted by the discovery of a curious reaction, by which also water and other substances may be decomposed. Metallic aluminium does not attack water by itself, neither does iodine; but if the three are brought into contact, oxide of aluminium is formed and hydrogen gas is evolved; and not only this, but the solution so produced will cause the oxidation of any excess of aluminium with the formation of an equivalent amount of hydrogen. It is not even necessary that free iodine should be employed, for iodide of aluminium itself will determine the oxidation of any amount of metal. This action is greatly quickened by coupling platinum with the aluminium. By employing alcohol instead of water a similar action is set up, and this has led to the discovery of aluminium ethylate, $\text{Al}_2(\text{C}_2\text{H}_5\text{O})_6$, alcohol in which the replaceable hydrogen is substituted by aluminium. It is a solid body at the ordinary temperature, but easily melts, and is capable of being sublimed unchanged, its vapour burning with a luminous flame and white smoke of the oxide of metal. Other compounds prepared by this singular reaction, and the nature of the chemical changes which occur, are at present the subject of study.‡

* Further particulars respecting the decomposition of water by this special kind of electrolysis may be found in *Proc. Royal Soc.*, 1872, p. 218; *Report Brit. Assoc.* 1872, Abstracts, p. 75; *Journal Chem. Soc.*, 1873, p. 452; *Phil. Mag.*, 1873, pp. 284, 285. The account of "Researches on the Action of the Copper Zinc Couple on Organic Bodies" is given in the *Journ. Chem. Soc.*, 1873, pp. 445, 678, 961; 1874, pp. 208, 406, 410, 615; 1875, p. 508. See also vol. vii. of *Proc. Roy. Inst. of Great Britain*, p. 521.

† *Journ. Chem. Soc.*, 1873, p. 541.

‡ Since this discourse was delivered, this peculiar reaction has been elucidated in a paper read before the Chemical Society, on "The Simultaneous Action of Iodine and Aluminium on Ether and Compound Ethers." An intermediate body, the aluminium iodoethylate, $\text{Al}_2(\text{C}_2\text{H}_5\text{O})\text{I}_2$, is there described.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 34.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

WHILST air is continually introduced so much lime is added that altogether 1.5 to 1.6 equiv. of lime may be present per 1 equiv. manganese, so that, deducting the lime necessary to form chloride of calcium, only about $\frac{1}{4}$ equiv. of lime may be present to 1 equiv. of manganese in the mud produced. This is at first white, but becomes gradually black as air is constantly introduced. For the charge of a cylinder to yield 2500 lbs. manganese there are required, for perfect oxidation, about 4956 cubic metres of air and five hours time; per lb. MnO_2 1.982 cubic metre of air is therefore requisite, of whose oxygen 14.8 per cent is actually utilised.

After completed oxidation the black manganese mud is passed into settling vats, in which it is allowed to deposit until its volume can be reduced one-half by syphoning off the supernatant solution of chloride of calcium. The mud thus concentrated contains about 141 lbs. peroxide of manganese per cubic metre, and is let off into suitable vessels for the production of chlorine.

The advantages of Weldon's process, according to the inventor, are:—The consumption of muriatic acid is smaller than when native manganese is employed, so that, at least in England, 4 tons chloride of lime can be produced, on Weldon's process, with the same quantity of acid which is required for 3 tons on the old process. In Germany and the Continent altogether the proportion may be less favourable, since the English method of developing chlorine in large stills by the introduction of steam is less economical than the Continental procedure in which small chlorine stills are heated externally. But even on the Continent the balance of the consumption of acid is in favour of Weldon's process. The consumption of muriatic acid per ton of chloride of lime is 3301 kilos. at 21° B.

A second advantage of the process is that the residues consist of a perfectly neutral solution of chloride of calcium, whilst on the old process they consist of the more dangerous acid manganese solution and of solid residues not easy to remove from the stills.

The labour required in Weldon's process is less than the old procedure, and the men are less injured by chlorine. For, since the agents, manganese mud, milk of lime, and muriatic acid, and also the residues are all liquids, it is no longer necessary to open the stills and remove the solid residues. Hence every occasion for polluting the air of the still-house by the introduction of chlorine is obviated. The stills are charged and emptied by simply opening cocks.

Weldon's process, lastly, is worked more rapidly than the old method, and requires a smaller number of sand-stone troughs, though the latter advantage is out-balanced by the cost of the oxidation apparatus. The productive power of a sand-stone apparatus was, on the old process, 1270 kilos. of chloride of lime weekly; whilst on Weldon's method in Allhusen's works, at Newcastle, the weekly production is 4572 kilos. In the same establishment four hours are required for the oxidation of 2500 kilos. of peroxide of manganese, being at the rate of 115 kilos. oxygen per hour.

The cost of the process in England as compared with the old method may be seen from the following statements of Weldon's:—

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

Per 1000 kilos. chloride of lime—

Weldon's Process.—Labour, 108. to 178.; coal, 750 kilos.; lime, 1400 kilos.; lime-stone for saturating the excess of acid, 250 kilos.

Old Process.—Labour, £2; manganese, £6; lime, 700 kilos.

(To be continued)

ON THE REQUISITE AMOUNT OF SIMPLE FRICTION OF SOFT IRON AGAINST COLD STEEL TO MELT IT.

By B. S. HEDRICK, of Washington, D.C.

THE development of heat by friction has been long known. For some time it has also been known that the operations of rolling and rubbing had the effect of changing the molecular structure of iron and steel. These operations will toughen and compact cold iron, and will harden and condense steel. Some time since Mr. Jacob Reese, of Pittsburg, Penn., had occasion to construct a machine for cutting bars of cold hardened steel. For this purpose he mounted a disc made of soft wrought-iron upon a horizontal axis, so as to be rotated with great velocity. With any moderate speed no cutting was produced; but, on giving the disc such a speed of rotation as to cause the periphery of the disc to move with a velocity of about 25,000 feet per minute (nearly 5 miles), the steel was rapidly cut, especially when the bar to be cut was slowly rotated against the disc. Sparks in a steady stream were thrown off. At first it was supposed that the steel was simply rubbed or ground off; but on examining the pile of accumulated particles beneath the machine, they were found to be welded together in the shape of a long cone, similar to the stalagmites in the limestone caves: they were nearly like the spikes of frost as formed in winter on Mount Washington, and illustrated at the Troy Meeting. Real fusion takes place. The steel is melted by the swiftly-moving smooth edge of the soft iron disc, but the disc itself is but little heated. The bar of steel on each side of the cut receives but a slight heat, and the ends are left with a fine smooth blue finish. By this process a rolled, polished, and hardened steel bar, of 2 or 3 inches diameter, may be cut in two in a few minutes. The soft metal disc of iron used was about 42 inches in diameter, and $\frac{1}{4}$ th of an inch thick. The particles fly off in a thick jet or stream apparently white-hot, through which the naked hand may be passed without injury, and a sheet of white writing-paper held in the stream for a minute is not burned nor coloured in the least. They glance off without burning the hand, having assumed the condition which causes the spheroidal state of liquids.—*Proceedings of the American Association for the Advancement of Science, Detroit Meeting, August, 1875.*

ON ROSCOELITE: A VANADIUM MICA.

By JAMES BLAKE, M.D., San Francisco, California.

THE mineral to which I have given the name of Roscoelite—in honour of Prof. Roscoe, of Manchester, who has done so much for the chemical history of vanadium—is a well-marked species of mica, containing quite a large percentage of vanadium. It was found in a gold-mine at Granite Creek, El Dorado County, in the lower hills on the western slope of the Sierra Nevada. It occurs in the hanging wall of a small quartz vein, the country rock being porphyry. The mica appears to have been principally deposited in fissures in the porphyry, and is usually found in layers from $\frac{1}{16}$ th to $\frac{1}{4}$ an inch thick, and seldom extending continuously for more than 2 or 3 inches. It

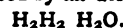
is also found filling cavities in the quartz. The crystal are quite brilliant, of a dark green colour, seldom more than 0.1 inch long, and, when occurring in fissures, form two series starting from each side of the fissure and meeting in the centre. They are also found in nodules with a stellar arrangement, more particularly in the cavities of the quartz. They are strongly double refracting. Sp. gr. 2.33. They weather into a light yellow wacke. The whole thickness of the vein-matter in which the mica is found is not more than a few inches. The mine in which it occurs has been worked for gold, and it is in these micaceous deposits that the greater part of the gold is found. Some portions are extremely rich, as much as 240 dollars having been washed out from a single panful; and while at the mine I saw 40 dollars taken from a few handfuls. The gold is commonly found in the form of fine scales which have been deposited between the crystals of the mica. So generally is it diffused that it is impossible to find a piece of the mica as large as a bean that does not contain gold. The mine is worked by means of an open cut, now about 30 feet deep and 150 feet long.

The most interesting fact connected with this mineral is the large proportion of vanadium it contains, and that, too, in a form in which it has not before been found, unless the small traces of it detected in some basalts should be part of an analogous compound. When I first discovered the mineral I expected to find a mica rich in chromium, and, on heating some of it in a test-tube with HCl, I obtained a green solution. Finding that by continued boiling with acid the whole of the colour was entirely removed from the mica, I availed myself of this method to determine the quantity of what I considered to be chromium; fusing the residue from the acid solution with carbonate of soda and nitre, and precipitating with lead, I also ascertained the amount of the alkalies; and, in presenting some specimens of the substance to the Microscopical Society, and at the Academy of Sciences of California, in September, I made the general statement that it was a potash-mica, containing 23 per cent chromic oxide and traces of lithia. It was not until I had sent a specimen of the mineral to Dr. Genth to analyse that the presence in it of vanadium was discovered, and to him is due the entire credit of having first detected the true character of this interesting mineral. I have availed myself of the action of nitro-hydrochloric acid on the mineral to prepare a considerable quantity of vanadic compounds for physiological experiment, as this affords about the easiest method of obtaining vanadic acid, although it is impossible thus to extract all the vanadium from the mica.—*American Journal of Science and Arts.*

ON ATOMICITY AS A PRINCIPLE OF CLASSIFICATION.

By M. BOURGOIN.

ATOMISTS have taken possession of Gerhardt's theory of types and have subordinated it to a more general principle, that of atomicity. They have said: there is a type *water*, because there exists a diatomic element, *oxygen*; a type *ammonia*, because there exists a triatomic element, *nitrogen*. Thus, in this way of looking at things, water would appear as hydrogen twice condensed, in which half the hydrogen is replaced by an atom of oxygen,—

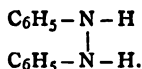


Ammonia is hydrogen three times condensed, in which three atoms of hydrogen are replaced by an atom of nitrogen,—

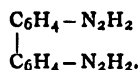


In this system they replace the simple notion of combination by that of substitution. On the other side, the symbolic radicals of Gerhardt have been analysed, dissected in a

certain manner; they have sought to establish between the atoms that compose them precise ties, admitting especially that, not only heterogeneous atoms exhaust among themselves their disposable atomicities, but that these latter may be interchanged between atoms of the same nature. These hypotheses, which are satisfactory enough when we are treating of saturated bodies, become insufficient when we seek to apply them to incomplete bodies. To remove these difficulties it has been proposed to substitute, for absolute atomicity of the elements, admitted in the outset by M. Kekulé, first, the principle of successive saturation of the atomicities of one and the same atom, the free atomicities of a polyatomic element being necessarily either even or odd; then the principle of relative atomicities, the atomicity of an element depending on the nature of the body with which it is combined. But these new hypotheses, as M. Berthelot judiciously remarks, render the whole atomic theory illusory and bring it back at last to the law of multiple proportions. However this may be, the atomicity of elements is become in the hands of atomists a fundamental principle of classification, not only for grouping simple bodies in natural families, but even for differentiating mineral and organic bodies. Let us take an example: hydrazobenzol and diphenylen-diamin are isomeric. We admit that in the former of these compounds the two atoms of nitrogen, which are not saturated, exchange between themselves their disposable atomicities:—



In diphenylen-diamin the nitrogen is saturated and the two phenylen groups exchange between themselves their two free atomicities:—

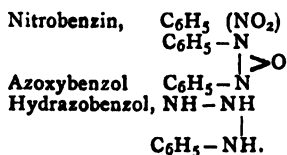


In my opinion the atomicity of the elements can only be admitted without question when treating of a definite specific property, as it belongs to atoms, but it is easy to demonstrate that there is nothing of the sort. Phosphorus combines at most with three atoms of hydrogen; it is then here triatomic, but it is pentatomic in contact with chlorine, because there exists a perchloride, PCl_5 ; with iodine it forms an iodide, PI_2 , which corresponds to no known chloride, &c.

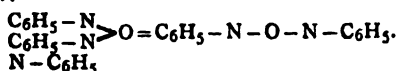
Nitrogen is monatomic in the protoxide of nitrogen, N_2O , as in the hyponitrite of silver of Mr. Divers:—



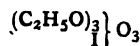
It is triatomic in ammonia, pentatomic in chlorhydrate of ammonia, in cyanuric acid, &c. Nitrobenzine gives successively by reduction, before yielding aniline, azoxybenzol, and hydrazobenzol:—



We admit that in the first of these compounds nitrogen is pentatomic, whilst it is only triatomic in two others; but, what shows, as we may say in passing, how subtle and arbitrary are these distinctions is that we may, with quite as much probability, maintain that nitrogen is only diatomic in azoxybenzol, in accordance with the following formula:—



Here are then three bodies which are derived regularly the one from the other and in which nitrogen plays a different part. It is pentatomic in nitrobenzin; triatomic or diatomic, at pleasure, in azoxybenzol; triatomic in hydrazobenzol. It is impossible in any natural classification to separate chlorine, bromine, and iodine; but whilst the two first are monatomic, iodine is decidedly triatomic in the compound, ICl_3 ; and it is the same in the triacetate of iodine of M. Schützenberger:—



The same difficulties exist with metals. Let us consider at first the metals reputed as diatomic—mercury, for example.

It may be asked, first, What is its atomic weight; second, What is its atomicity? To determine its atomic weights we found upon its vapour-density and on the law of Dulong and Petit. Experiment shows that the density of mercury is equal to 6.97, whence we deduce for its atomic weight with reference to hydrogen:—

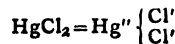
$$\frac{6.97}{0.0693} = 100$$

On the other hand, according to the consideration of specific heats, its atomic weight is equal to 200—

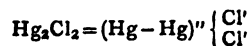
$$\frac{6.4}{0.0324} = 200$$

It has been sought to explain this anomaly by saying that the atom of mercury occupies two volumes, a supposition inadmissible, for it constitutes a true begging the question. To remove this difficulty there is only, as it seems to me in the present state of science, one plausible explanation, that is, to admit that atomic weight may vary according to the physical state of the bodies; for mercury in the solid as in the liquid state the vibrating mass is equal to 200; in the gaseous state it is equal to 100. But what becomes then of the invariability of the atomic weights?

Second, mercury forms with chlorine two compounds. We admit that it is diatomic in sublimate.



To preserve for it the same atomicity in calomel it has been assumed that this latter compound has for its formula:—



Messrs. Deville and Troost have found that the density of calomel is 8.2 and as there is no dissociation, according to M. Debray, we have for its molecular weight referred to two volumes, hydrogen being taken as unity—

$$\frac{8.2 \times 2}{0.0692} = 236$$

On the other hand,—

$$\left. \begin{array}{l} \text{Hg} = 200 \\ \text{Cl} = 35.5 \end{array} \right\} = 235.5$$

The formula of calomel is then HgCl , a compound in which mercury is monoatomic. Mercury is therefore sometimes monoatomic, sometimes diatomic in contact with chlorine, which amounts to saying purely and simply that it obeys the law of multiple proportion when it forms several compounds with the same element. The difficulties are still greater when we consider the polyatomic metals, such as iron and manganese. Manganese is monoatomic in permanganic acid; diatomic in protoxide of manganese; diatomic or tetraatomic in pyrolusite; tetraatomic in fluo-manganic acid; hexatomic in the manner of ferric in braunite; probably heptatomic in the perchloride of M. Dumas, &c. According to the preceding it appears to me doubtful whether

elements can serve for a principle of classification, whether for simple bodies or for compounds.

But the word *atomicity* has been employed in another and perfectly legitimate sense as representing the relative value of molecules among themselves. Thus understood, this notion becomes an important principle of classification, on which it is proper to insist. In 1838, Graham showed that in neutral phosphate of potassium there are three atoms of potassium, and that the acid phosphates differ from this salt only because they contain atoms of hydrogen instead of atoms of potassium. We may remark that it is impossible to divide by 3 the atoms of oxygen in neutral salts, and that, accordingly, these latter contain probably in their molecules three times more potassium than, e.g., nitrate of potassium. We may make an analogous remark concerning the citrates, which are tribasic; for if the atoms of carbon are divisible by 3, it is not the same with the atoms of oxygen and of hydrogen. In the year 1838, Liebig insisted on the necessity of regarding as polybasic the cyanuric, melonic, comenic, citric, aconitic and aconic, tartaric, malic, and fumaric acids. Other proofs came to the support of this view, which is now adopted by all chemists. It is thus that phosphoric ether contains in the same volume three times as much carbon as nitric ether; and this circumstance is decisive, for it shows that the existence of polybasic molecules is in perfect agreement with the gaseous densities of the ethers. We are thus led with M. Berthelot to consider the molecule of a bibasic acid as resulting from the fusion of two monobasic intimately united. These notions on the acids at first defined in mineral chemistry find their application in organic chemistry, which permits us to deduce from them important rules of classification. Let us cite an example. Formerly we expressed formic acid and oxalic acid by formulæ containing the same quantity of carbon; but whilst the former only gives with bases a single series of neutral salts, the second furnishes likewise acid salts and double salts, which is explained in a most natural manner by admitting that the oxalic molecule contains twice as much of carbon as the formic molecule. On the other hand, experience shows that whilst a litre of formic ether contains the carbon of a litre of alcoholic vapour, oxalic ether contains in the same volume the carbon of two litres of vapour of alcohol; it is thus proved that in this latter case the carbon has a condensation double of that which it possesses in formic ether; and thus the molecule of oxalic acid possesses a double capacity of saturation. Analogous considerations are applied to alcohol. They were introduced into science for the first time by M. Berthelot, in consequence of his fundamental researches on glycerin. In fact, there where ordinary alcohol produces only a single compound, with acids glycerin produces three. Or in general terms a single molecule of glycerin may experience three times any one whatsoever of the reactions which are applicable to ethylic alcohol, either separately or simultaneously. Here is, then, a structure which is equivalent to three molecules of ordinary alcohol, a fact which is expressed in a single word by saying that glycerin is triatomic. These considerations naturally lead us to the conception of mixed functions so diffused amongst organic compounds. It is thus that glycol, which is a diatomic alcohol, gives on oxidation two acids: first, glycolic acid, which is at once a monoatomic alcohol and a monobasic acid; secondly, oxalic acid, in the molecule of which the acid function is repeated twice. Let us remark, finally, with M. Berthelot, that the atomicity of alcohols may be defined in the following manner:—An alcohol is *monatomic* when it contains the elements of a single molecule of water replaceable by an equivalent quantity of any acid whatever; it is *diatomic* when the elements of two molecules of water may be replaced separately or simultaneously by two molecules either of one and the same acid or of two other different acids, &c. This atomicity by substitution, thus defined, is secure from all objection, and it ought to be carefully distin-

guished from the atomicity of elements or the atomicity of addition which is contestable. Finally, it becomes in the hands of chemists a powerful means of classification, since it allows us to distinguish simple functions: first, repeated functions; second, mixed functions. But the notion of function ought, in the present state of science, to be regarded as the basis of every system of chemical classification.

MINERAL PHOSPHATES AND SUPERPHOSPHATE OF LIME.*

By WALTER C. REID.

THE rapid development of the manufacture of artificial manures, and the total inadequacy of bones and bone-ashes to meet alone the requirements of this trade, have caused the consumption of mineral phosphates to increase of late years to an enormous extent; and it is of importance for manufacturers, and others who buy and sell, to know the composition of the raw and manufactured materials, and the influence of the several constituents of the former upon the production of the latter.

The basis of nearly all fertilisers and the staple product of all manure works is superphosphate of lime, and in producing it much depends upon the care and attention given to the selecting of the raw materials, as well as to preparing and dissolving them, for, simple as the process appears, if these are neglected an article quite unfit for use is almost certain to be the result.

Deposits of raw phosphatic materials having different characteristics, in physical appearance and in chemical composition, as well as in the results obtained from them, have been found in nearly every part of the globe. The commercial value of these is chiefly regulated by the percentage of tribasic phosphate of lime they contain. The richer they are in this element the more valuable they are (*ceteris paribus*) for the manufacture of superphosphates. But the amount of phosphate of lime in a mineral cannot be taken as the only criterion of its value, for it sometimes happens that a phosphate containing a lower percentage of this ingredient will make a stronger and better superphosphate than a richer one containing more deleterious impurities. The value is very much affected by the amount of carbonate of lime, iron, alumina, and fluoride of calcium present; also by its porosity or density, and facility with which it can be reduced to a fine powder. If not in an excessive quantity, carbonate of lime is rather an advantage than otherwise in the manufacture of a good-conditioned superphosphate, inasmuch as the carbonic acid disengaged from it when acid is applied makes a mass more bulky and open, and causes it to appear porous or honeycombed when finished.

The presence of a large quantity of iron and alumina in mineral phosphates is objectionable, for they not only absorb acid, but superphosphates made from them have a tendency to "go back," or become insoluble again; therefore the unit percentage of phosphate of lime is worth less in minerals containing a good deal of these than in others containing only a little. Fluoride of calcium, which generally accompanies phosphatic minerals, also reduces their value. It wastes acid, and in becoming a sulphate of lime its weight is increased to the detriment of the superphosphate. Silicious matter is a useless ingredient, but a harmless one, except in so far as it causes an unnecessary weight to be moved about, and when in excessive quantity reduces the proportion of soluble phosphate in the superphosphate to such an extent as to make it unmarketable. Ordinary mineral superphosphate contains biphosphate of lime equal to 25 to 28 per cent of tribasic phosphate of lime rendered soluble; and, as it is well known that good Cambridge coprolites are capable

* A Paper read before the Newcastle-upon-Tyne Chemical Society.

of yielding this of a good chemical composition, and in a dry powdery condition, the analysis of this mineral may be taken as a fair standard upon which to assess the value of others.

Cambridge Coprolites come from the Upper Greensand in Cambridgeshire, and occur as small nodular hard masses of a grey colour, and are supposed to be fossil excrement of animals, or occasionally concretions around bones, amongst which are found fish-teeth and some vertebræ. Either from the exhaustion of the better sorts or from imperfect washing the quality has lately somewhat deteriorated, and there is now some difficulty in making superphosphate from them to contain more than 25 per cent of soluble phosphate.

The following tests were made before this deterioration:—

	1.	2.	3.	4.	5.
Tribasic phosphate of lime.. .. .	60.87	58.52	27.12	54.89	57.09
Carbonate of lime	18.25	12.47	11.66	15.13	13.27
Oxide of iron and alumina	5.30	3.49	4.44	3.82	3.24
Fluoride of calcium	1.80	2.20	3.00	4.00	4.33
Insoluble silicious matter	6.50	6.04	6.22	8.64	6.93

These coprolites are extracted by washing from a stratum not more than 1 foot thick. An average yield is 300 tons per acre, and sometimes enormous prices are paid (up to £300 per acre) for the privilege of digging them. In making contracts for superphosphates it has hitherto been a very common practice for buyers to stipulate for them to be made from Cambridge coprolites only.

Coprolites are also raised in Suffolk, Bedfordshire, and Buckinghamshire, in England; also, largely in France and in Russia; but these all contain much iron or silica and other impurities, which reduce the quantity and depreciate the value of the phosphate of lime in them. It is chiefly from the neighbourhood of Boulogne, in the North of France, that the French coprolites are sent over to England, and these are largely used for mixing with richer descriptions of phosphates. They occur as dark grey nodules, larger than those from Cambridgeshire, and are rich in organic remains. An excessive quantity of silicious matter is their chief impurity, and the cause of the low percentage of phosphate of lime, which seldom exceeds 45 per cent.

Analysis of Boulogne Coprolites.

	1.	2.	3.
Triphosphate of lime	46.45	48.0	43.3
Carbonate of lime	11.93		
Iron and alumina	7.29	20.00	22.9
Fluoride of calcium	2.08		
Insoluble silicious matter	23.56	28.1	28.2

There are also coprolite beds in France, in the Valley of the Rhone near Switzerland, and in the Ardennes near to Belgium, where it is thought worth while to go nearly 200 feet deep through an argillaceous clay to obtain them; but the cost of carriage is too great to allow them to be exported from these places to England.

Suffolk Coprolites are found adjacent to the London Clay, and consist chiefly of rolled pebbles, with a small proportion of more or less perfect specimens of bones of various animals, as also some fish and Crustacea. They were formerly regarded as fossilised excrements of animals, for which reason they were called coprolites; but they are now supposed to be calcareous pebbles which have undergone a peculiar change, and become impregnated with phosphoric acid by long-continued contact with decaying animal and vegetable matter.

The name pseudo-coprolite has been given from their resemblance to the Cambridge coprolites, but they are distinguished from the latter by a brownish ferruginous colour and a smoother surface. They are very hard, and generally contain too much oxide of iron and alumina to

allow them to be used safely in the manufacture of superphosphates.

Analyses of Suffolk Coprolites.

	1.	2.	3.	4.
Triphosphate of lime.. .. .	53.4	61.3	52.5	56
Carbonate of lime	17.5	11.6	12.2	10
Iron and alumina	10.4	4.8	8.5	8
Fluoride of calcium	1.4	3.0	4.3	3
Insoluble matter.. .. .	9.7	10.6	12.2	12

Wicken, Bedfordshire, and Russian coprolites (the first a poor variety from Cambridgeshire) resemble the Suffolk in their chemical character, and have the following approximate composition:—

	Bedfordshire. Wicken.		Russian.	
	1.	2.	1.	2.
Triphosphate of lime.. .. .	50	36	33	48
Carbonate of lime	8	10	5½	
Iron and alumina	8	12	6	12
Fluoride of calcium	4	2	3½	
Insoluble matter.. .. .	20	28	43	30½

South Carolina or Charleston Phosphate stands next in importance to Cambridge coprolites as raw material for manure-making. This is found in the calcareous strata of the Charleston basin, occupying an irregular area of 50 or 60 miles, and partly underlying the city of Charleston. It consists of irregular-shaped nodules, associated with fossil bones of marine and land animals which are found embedded in a stratum of clay and sand about 2 feet thick. There are two kinds, the land and the river deposit. The former is of a fawn-colour, and easily ground, but there is some difficulty in washing away all adhering clay, &c., and it is chiefly kept for home use. The river phosphate has become a formidable rival to Cambridge coprolites, and in some respects it is found to be superior to our native mineral. It is dark, almost black in colour, and rather harder than the land variety, and, notwithstanding that it makes a very dark-coloured superphosphate, it is very much liked by manufacturers. It is dredged from the rivers, and the mud and sand are washed away on board of the dredgers.

The following represents approximately the composition of the river phosphates:—

Triphosphate of lime	54
Carbonate of lime	14
Iron and alumina	3½
Fluoride of calcium.. .. .	2½
Insoluble silicious matter	15

As compared with Cambridge coprolites, this mineral is more easily dissolved, and a greater portion of the phosphates is rendered soluble, but it takes longer to grind, and the millstones are more quickly worn. The mineral known as—

Lot or Bordeaux Phosphate comes from the Departments of Lot and Lot et Garonne, in France. It occurs in pockets or fissures and veins of the limestone, and also in thin layers, near the surface. These are covered with an alluvial soil and clay, containing phosphates, but much contaminated with iron and other impurities. The pockets, of all shapes and sizes, and sometimes reaching 100 feet deep, are generally traced and indicated by narrow vertical veins of deposit, which rise from them to the surface, and are mostly found on the highest ground. It varies greatly in appearance, texture, and composition. Occasionally it is found in snow-white compact masses, breaking with an earthy fracture, and of a moderate degree of hardness. The more ordinary kinds are of a dark yellow or brown, dense, and hard; but it is frequently found of a dark agate colour, somewhat resembling the inside of broken flints, of a waxy lustre, stratified and intersected with thin layers of oxide of iron. It has the appearance of being an aqueous deposit; and the probab-

cementing together of lumps of phosphates, bones, &c., with more or less alluvial clay and earth, by the percolation of dissolved phosphatic matter, may account for the appearance, texture, and composition of some portions. The white specimens are generally the richest, some being as high as 85 per cent, with a minimum ($\frac{1}{4}$ per cent) of iron, &c., but the bulk of cargoes received here only contain 70 to 72 per cent, and with 4 or 5 per cent of iron, &c. Fossil bones and teeth are found in quantity. The surface phosphatic earth finds a ready sale on the spot.

Analyses of Two Sample Parcels of Lot Phosphate.

	Best Quality.	Poor Quality.
Triphosphate of lime	67.19	55.45
Carbonate of lime	15.31	8.30
Iron, alumina, fluorides, &c.	4.20	12.86
Silicious matter	5.20	19.13

The best varieties of these phosphates are well adapted for the manufacture of superphosphate. Most of the large Lot mines are owned and worked by English firms, amongst which is a Newcastle Company.

To be continued.)

NOTICES OF BOOKS.

Treatment of Ores. By THOMAS CLARKE, M.D., and EDWARD SMITH, F.C.S. Torquay: Directory Office.

This pamphlet is an account of a patent granted to the authors, No. 4448, December 26, 1874. The patentees claim, in addition to improved methods of concentrating the ores and of applying a hot or cold blast in roasting and "chloridising" the employment of alkaline hyposulphites and of ammonia separately or jointly for the solution of the metals, an improved method of separating silver, the use of superheated steam if hyposulphites alone are used, and the passing of galvanic currents to aid the galvanic action, and the mixing with the solution any requisite quantity of powdered copper precipitate. There are also a number of improvements in the construction of the working plant.

Chemical Analyses and Commercial Values and Prices of Fertilisers Sold in Georgia for the Season 1875-76, to which are Appended Formulae for Composting Fertilisers at Home, and Reports of Experiments. Published under the Direction of the Commissioner of Agriculture for the State of Georgia.

THE nature of this pamphlet will be easily understood from its title. The fertilisers, or manures as we should call them, met with in commerce in Georgia, have been analysed by Mr. W. J. Land, chemist to the Department of Agriculture, and the results tabulated. What are called the "commercial values," as contradistinguished from the "prices," are, we presume, what are in England known as "agricultural values." It will be remarked that they approach very closely to the market prices, and sometimes even exceed them. There appears to be in various parts of America a disposition to condemn chemical manures. The latter of course may be dispensed with if all the excrements, liquid or solid, of every being fed upon the produce of the farm can be returned without waste to the soil. Where this is not the case a deficiency in the ingredients necessary for good crops will gradually arise, and can only be compensated by the use of so-called artificial manures. We are much interested to find that in the eyes of American agricultural chemists potash takes a rank higher than it holds—or rather held—in England. Experiments made with potash salts in this country were often found in past days to give a merely negative result. The case is now different. Increased

crops have been obtained by means of manures rich mainly in phosphoric acid and in nitrogen. In consequence the potash of the soil has been taken up in a relatively increased ratio, and is becoming exhausted. Hence Stassfurt salts are very naturally found to produce a beneficial effect.

A Plan for Rendering Salted Meat more Nutritious, thereby Preventing Scurvy. By R. GALLOWAY, F.C.S. Dublin: Hodges, Foster, and Co.

THE author's plan is very simple, and, as it seems to us, very feasible. He proposes to add to the meat phosphate of potash, a constituent of which it is deprived by the process of salting.

CORRESPONDENCE.

ANALYSES OF MANGANESE ORE.

To the Editor of the Chemical News.

SIR,—Dr. Phipson's last letter (CHEMICAL NEWS, vol. xxxiv., p. 39) is a remarkable example of argument in a circle.

I ask him how he distinguished Mn_2O_3 from a mixture in atomic proportions of MnO and MnO_2 . He replies, "by determining the manganese and oxygen." I point out that such a method is inadequate, the elementary composition being the same in each case. I ask again, how he knows that his assumed Mn_2O_3 was not really $MnO + MnO_2$, and I get the reply, "because there is no MnO in the sample."

Really such an answer is childish, and an insult to the readers of the CHEMICAL NEWS.

As Dr. Phipson is evidently desirous of fencing with the question, and apparently has no information to impart, I am unwilling to take up space by further discussing the matter, but will ask Dr. Phipson for full and straightforward replies to the following questions:—

1. How did Dr. Phipson ascertain that MnO was not present, the method which he stated he used for the purpose having been proved quite inadequate?

2. If the determination of the total quantity of oxygen and the total quantity of manganese furnish sufficient data for the purpose, as stated by Dr. Phipson, will your correspondent inform me what proportions of MnO_2 , Mn_2O_3 , and MnO would be present in a sample containing 69.62 per cent of manganese and 30.38 per cent of oxygen?—I am, &c.,

ALFRED H. ALLEN.

Sheffield, July 29, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 1, July 3, 1876.

Fermentation of Urine.—MM. Pasteur and J. Joubert.—An enquiry into the cause of the rapid formation of carbonate of ammonia in urine after leaving the bladder.

Observations on the Foregoing Communication.—M. Berthelot.—The author refers to his paper on ferments (*Comptes Rendus*, tome I., p. 983, 1860).

Third Note on Electric Transmissions through the Soil.—M. Th. du Moncel.—Not adapted for abstraction.

Metallic Nickel Extracted from the Ores of New Caledonia.—MM. P. Christoffe and H. Bouilhet.—These

ores seem to belong to three distinct types—An emerald green hydrosilicate, compact and hard, containing 18 to 20 per cent of nickel and 5 per cent of water; a yellowish green hydrosilicate, more friable, and containing 12 to 15 per cent of nickel and 10 to 15 of water; a whitish blue hydrosilicate, very brittle, and easily crushed with the fingers, containing merely 6 to 8 per cent of nickel, and as much as 20 per cent of water. The metallic nickel extracted from these ores contains from 98 to 99.5 per cent of pure nickel.

Radiometer of Mr. Crookes.—M. G. Govi.—The author combats the objection raised against his theory from the fact that a radiometer surrounded by a circle of lights does not come to a stop. He argues that in a circle of candles, where the intensity of the light varies without ceasing, and where currents of air may cool the small glass case irregularly, the point of thermic equilibrium, which would stop the rotation, would only be reached with great difficulty. He maintains that a uniform temperature ought to produce continual rotation as well as a continual access of light. He describes an experiment in which a very sensitive radiometer, with discs of aluminium polished on one side, and of mica blackened on the other, and placed in a cylinder of glass, into which the steam of boiling water was passed continuously, began to turn with great velocity, the aluminium sides foremost as soon as the steam had begun to raise the temperature of the case. By-and-bye, the temperature remaining invariable, the rotation slackened, and finally stopped as long as the heat was constant. When the access of the steam was cut off the radiometer began to turn in the contrary direction, and continued so for a long time. Any radiometer may be made to turn in this direction by plunging it into a vessel of cold water. It begins to move immediately, the blackened side of the discs foremost, and only stops after a certain time, *i.e.*, when a new state of thermic equilibrium has been reached. If the instrument is then taken out of the cold water it begins to turn in the same manner as if it had been exposed to light, even though it is all the time in the most profound darkness. If for the discs of aluminium and blackened mica we substitute a set of burnt mica, blackened on one side, the phenomena are complicated, whether because of the bad conductivity of the mica, or because at a certain temperature the nacreous surface of the mica absorbs much obscure heat, and gives off more gas than the blackened side. Thus, in the case heated to 100°, this radiometer turns regularly for a certain time with the nacreous surfaces foremost, then stopped, and began to turn in the contrary direction. The author then describes some unsuccessful attempts made to eliminate the gases adhering to the discs.

Explanation of the Movement of the Radiometer by the Aid of the Theory of Emission.—M. W. de Fonvielle.—The blank surface which reflects the light, and behaves like an elastic surface, ought to be more energetically repelled than the black if the luminous molecules act like masses striking the surfaces of the radiometer. But this principle supposes that the speed of the shock is not superior to the speed of the propagation of molecular movements, which latter is less than that of a ball proceeding from a revolver. This applies *a fortiori* to the shock produced by the luminous molecules, whose speed is a thousand times greater than that of a bullet. In this case, therefore, the absorbing or obscure surfaces should be repelled.

Radiometer of Mr. Crookes.—M. E. Ducretet.—The radiometer being exposed to ordinary daylight, its discs take a movement of direct rotation, the black surfaces being repelled. If ether is poured upon the case the movement is stopped, and then re-commences in an opposite direction. This reaction soon ceases, and we see the discs resume the original direct movement, in spite of the evaporation on the glass case, kept up by a gentle sprinkling with ether. At this moment the rotation becomes more rapid than at first, the evaporation seeming to act as if it

were a source of heat, and yet the fall of temperature caused by the evaporation of the ether is very distinct. As soon as the application of ether ceases the movement resumes its normal speed, and remains direct. To repeat these experiments it is necessary to wait till the interior temperature of the radiometer has become equal to that of the surrounding air. The author has exposed a radiometer fixed in a dark place to the action of some tubes filled with phosphorescent powders, rendered very luminous by a previous exposure to the sun. There was no movement. The author is constructing a radiometer in which the reflecting surfaces are covered with very phosphorescent powders, whilst the other surfaces are blackened.

New Battery with Peroxide of Manganese.—M. G. Leclanché.—Not adapted for abstraction.

Action of Hydracids upon Selenious Acid.—M. A. Dittz.—With dry hydrochloric acid gas the result is a compound, SeO_2HCl . It is a liquid of a pale amber colour, and is capable of absorbing more hydrochloric acid, forming a solid crystalline body, $\text{SeO}_2\cdot 2\text{HCl}$. Selenious acid absorbs hydrobromic acid very greedily, forming a mass of steel-grey crystals, composed of—
 $\text{SeO}_2\cdot 2\text{HBr}$.

Decomposition of Insoluble Carbonates by Sulphuretted Hydrogen.—L. Naudin and F. de Montholon.—Carbonate of baryta suspended in water is completely converted into sulphide of barium by a sufficiently prolonged current of sulphuretted hydrogen. With other insoluble carbonates experimented upon the transformation is equally complete.

New Method of Substitution of Chlorine and Bromine in Organic Compounds.—M. O. Damoiseau.—The author makes use of a peculiar animal charcoal, prepared according to the method of Bussy, by calcining a mixture of dried blood and carbonate of potash. When cold it is carefully lixiviated, and calcined again at the highest possible temperature. The compounds studied have been formed in the pores of this charcoal.

Synthesis of Allantoin.—M. E. Grimaux.—The synthesis of allantoin and that of parabanic acid realise the synthetic reproduction of all the derivatives of the parabanic group.

A New Butylic Glycol.—M. Nevolé.—Not adapted for abstraction.

New Alcoholometric Method by the Distillation of Alkalimised Spirituous Liquids.—M. E. Maumené.—Measure at + 15° C. 200 c.c. of the spirituous liquid in question, brought if needful to 14 or 15 per cent of alcohol at most; neutralise this volume with caustic soda in slight excess; distil this liquid to the half or 100 c.c., also at + 15°, and measure the alcohol by means of a good centesimal alcoholometer. If this liquid, examined with two drops of litmus or with turmeric paper, appears to contain an appreciable quantity of ammonia it is neutralised with a few drops of water, and the 110 to 120 c.c. made up by the washing-waters are distilled down to 100 c.c. at + 15°. The alcoholometer on immersion into this liquid gives its exact percentage of alcohol.

Detection of Magenta in Wines.—M. E. Jacquemin.—The author dyes wool with an ethereal extract of the colour separated from the wine by means of agitation with ammonia and ether.

On Nitralizarin.—M. A. Rosenstiehl.—The author admits that this compound was first produced by Mr. W. H. Perkin.

Moniteur Scientifique, du Dr. Quesneville,
July, 1876.

Review of Physics.—M. R. Radau.—This consists of notices of the coefficient of dilation of the air; on electric and thermic conductivity; on new pyrometers; on Stoney's new spectroscope; on the measurement of the refractive indices of liquids: and on the relative value of metals

Vanadium, we find, is stated to be worth 28,680 francs per kilo., or, in round numbers, seven times as much as gold.

Action of Ammonia and the Compound Ammonias upon the Phospho-platinous and Phospho-Platinic Chlorides.—M. G. Quesneville.—Not adapted for abstraction.

Researches on Viscous Fermentation.—M. A. Commaile.—The continuation of a lengthy treatise.

Resorcin, and its Different Methods of Preparation.—M. F. Reverdin.—Reserved for insertion in full.

Colouring Matters Derived from Resorcin.—M. L. Durand.—Reserved for insertion in full.

Use of Alkaline Sulphides in Dressing Hides.—A. Gelis.—The author points out that the use of alkaline sulphides in removing the hair from hides represented as a recent German invention is really due to MM. Boudet and Domminge, who took out a French Patent for the process as early as 1838.

Importance of Sulpho-carbonates as a Remedy for the Phylloxera.—(Extract from a report read April 25, at the session of the General Council of Saône et Loire.)—The writer maintains that the sulpho-carbonates, though successful in small experimental operations, have proved a failure when tried upon a practical scale.

New Volumetric Process for the Determination of Astringent Matters.—M. F. Jean.—Already noticed.

Freezing Machines with Sulphurous Acid.—M. Raoul Pictet.—This paper is, in a great measure, modelled upon the section on artificial cold in Dr. Hofmann's *Berichte*, which appears in the *CHEMICAL NEWS*.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 31, July, 1876.

This issue contains nothing of scientific interest.

Les Mondes, Revue Hebdomadaire des Sciences, No. 10, July 6, 1876.

This issue contains no chemical matter.

No. 11, July 13, 1876.

The Abbé Moigno writes:—Having studied the radiometer made by MM. Alvernnot Frères, I am inclined to believe that the movement must be ascribed to an effect of reaction exercised by the gas which, first absorbed by the blackened surface of the discs, is disengaged in darkness, re-absorbed under the influence of light, again evolved, &c. He connects the phenomena of the radiometer with the attraction and repulsion exerted by light upon plants.

Experiments on the Combustion of Organic Matter under the Double Influence of Heat and Oxygen.—M. Désiré Loiseau.—An interesting paper, which would be of little value except accompanied by the needful illustrations.

MISCELLANEOUS.

University of London.—The following is the List of the candidates who have passed the recent first B.Sc. examination:—*First Division*: A. Black, private study; T. Bolton, University College; E. H. Cook, Royal College of Science, Dublin; R. H. Cotton, B.A., Owens College; A. Cutfield, Epsom College; A. W. Dallmeyer, University College; W. Fisher, B.A., private study; W. Fream, Royal College of Science, Dublin; T. Gough, private study; W. H. Higgin, Owens College; E. Hopkinson, Owens College; W. E. Hoyle, Owens College

and Christ Church, Oxford; G. W. Mackie, B.A., private study; H. Major, B.A., private study; H. F. Morley, B.A., University College; M. F. O'Reilly, St. Joseph's College, Clapham; J. A. Owen, private study; J. H. Paul, private study; J. M. Raby, B.A.; Owens College; H. L. T. Sack, B.A., private study; R. K. Sen, Edinburgh University; G. Severs, private study; J. Shirley, private study; T. B. Silcock, private study; G. T. Smith, private study; J. Stephens, University College and private study; T. E. Vasey, private study; W. L. Wills, Owens College; J. T. Wright, private study; R. B. Yardley, University College. *Second Division*: A. Atmaram, University College; B. Borrah, University College; W. K. Griffin, University College; E. J. Hodges, private study; T. Isherwood, Owens College and private study; M. Knowles, private study; L. Larmath, Owens College; W. Palmer, University College; J. Runciman, private study; B. J. Snell, B.A., New College; J. Trubert, St. Joseph's College, Clapham; H. W. Turner, University School, Hastings, and private study; H. Ulyett, private study; J. B. Wohlmann, B.A., private study.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of human excreta, and in the manufacture of manure therefrom, and in the apparatus employed therein. F. G. Whitwham, Cannon Street, London. (A communication from F. A. Bonnefin, Island of Mauritius.) April 2, 1875.—No. 1195. This invention relates to the treatment of human excreta, and to the production of manure therefrom, and consists of a peculiar process of and apparatus for effecting the deodorisation or disinfection of the solid and liquid portions together, and of the liquid portion separately, in order to fix the salts and gases, and render the excreta capable of being employed as a manure for agricultural purposes.

An improved method of and apparatus for treating faecal matters so as to destroy their noxious qualities and to obtain useful products therefrom. W. E. Newton, Chancery Lane, Middlesex. (A communication from A. Sindermann, Breslau, Germany.) April 3, 1875.—No. 1216. The faecal matters are first subjected (under great heat) to distillation, and thus are separated into their solid and gaseous or volatile parts. Whilst the solid matters remain behind in the retort, the volatile or gaseous parts pass through a tube into a vessel in which the tar is deposited, and from thence they pass into other parts of the apparatus, and are at last converted into illuminating gas.

Improvements in the composition and manufacture of bituminous and other compounds, and in the application of such compounds to paving and other purposes. G. Clark, Craven Buildings, Drury Lane, Middlesex. April 5, 1875.—No. 1220. (1) The production and manufacture of a bituminous compound, having asphaltum as its base, and in blocks similar in character to native rock asphalt, and designated in the Specification as asphaltum mastic and complete mastic, which may be easily heated in a copper, and readily used when so heated for paving or other purposes. (2) The combination of wood with asphaltum or any other bituminous or other plastic compound in the form of blocks for paving purposes, composed of any such bituminous or other plastic compound contained in a wooden box or frame or part of a frame, forming an outer casing, wholly or partially, to the said block, and laid down as paving in the manner described in the Specification. (3) The use of sawdust or any vegetable particles of fibre, wool, or hair as part of the materials, separately, or any one of them mixed with one or more of the others, in any bituminous compound made as described in the Specification for paving or other purposes.

Improvements in the manufacture of sugar. A. V. Newton Chancery Lane, Middlesex. (A communication from F. O. Matthiessen, New York, U.S.A.) April 5, 1875.—No. 1234. The contents of the vacuum pan (consisting at this stage of the manufacture of crystal floating in a medium of syrup) are run out through a cock or valve in the bottom thereof into a separate vacuum chamber where a further concentration is effected before submitting the sugar to the clarifying operation.

Improvements in the preparation of oils to fit them to be mixed with varnishes or dissolved gums. M. Zingler, Buckland Crescent, Belsize Park, Middlesex. April 8, 1875.—No. 1276. Castor oil or other non-drying oil to be mixed with varnishes or dissolved gums is prepared by heating the oil with a small proportion of anthracene, or by adding to it without heat a small quantity of tetrachloride of carbon. Linseed oil or other drying oil is prepared in a similar manner, so that it may mix without heat with varnishes or dissolved gums: or linseed or other drying oil to be mixed with varnish is prepared by dissolving rosin in the oil by means of heat, and turpentine or methylated spirit are then added.

Improvements in treating and refining tallow and other fatty substances. R. Lavender, Kircaldy, Fife. April 9, 1875.—No. 1291. This Provisional Specification describes melting tallow, and mixing it with naphtha; when cold it is bagged and subjected to pressure, by which the oily matters and solvent are expressed.

Improvements in the treatment of sulphur ores. A. A. Croll, Coleman Street, London. April 10, 1875.—No. 1307. The object of the invention is to subject ores containing sulphur to a certain degree of heat obtained by the passage of atmospheric air through charcoal, coke, or other carbonaceous matter in the state of ignition. For this purpose the chamber for the ignited carbonaceous matter is in direct communication with one, or it may be several, close chambers containing the sulphur ore to be acted upon. To facilitate the action of the heat on the ore, such ore is previously broken up into comparatively small particles, and these are supported on grating or reticulate work, the openings through which are close enough to prevent the particles of ore passing through, whilst they yet admit of the free passage of the fluid sulphur obtained by the action of the heat.

Improvements in the manufacture of aerated waters, and in apparatus and vessels therefor. W. F. C. S. Corry, Belfast, Antrim, Ireland. April 12, 1875.—No. 1318. The manufacture and preservation of aerated waters free from noxious ingredient or objectionable metallic or other impregnation, and the construction of apparatus and vessels therefor, consisting in whole or in part of glass, china, delft, porcelain, clay, earthenware, pottery, agate, flint, marble, or other stone, cement, alabaster, enamel, glaze, platinum, gold, silver, ivory, bone, horn, ebonite, vulcanite, india-rubber, gutta-percha, asbestos, leather, hide, wax, shellac, resin, catgut, teak, cork, ebony, lignum-vitæ, oak, horn-beam, or other wood, paper, or other plastic material, or of a combination of the same, which may be imbedded or enclosed within, or contain, or be supported by, metal or a combination of metals, or be used for coating or plating the apparatus or vessels heretofore employed.

Improvements in the manufacture of alkali. H. Gaskell, Widnes, Lancashire. April 12, 1875.—No. 1323. This invention relates to that stage in the manufacture of alkali in which black ash is made in revolving furnaces: consists in first charging the furnace either with salt-cake and a portion or the whole of the "slack," or with salt-cake alone, and when the salt-cake has "fluxed" or "softened," so that it occupies less space in the furnace, adding the remainder of the charge.

Improvements in the manufacture of candles. P. Lombardon, Sydenham Park, Kent. April 12, 1875.—No. 1327. To this end I make use of tallow (by preference the soap made according to an improved process for which I have obtained Letters Patent, dated October 27, 1874).

Improvements in the treatment of sewerage with a view of extracting the fertilising products therein contained, and in the apparatus employed for that purpose. W. Morgan-Brown, Southampton Buildings, London. (A communication from G. P. Harding and J. R. Johnson, Rue Gaillon, Paris.) April 13, 1875.—No. 1335. This invention describes the extracting fertilising products from sewerage by allowing the liquid to flow in wide and shallow currents over a very slightly inclined surface: the tendency of this arrangement is to cause a rapid settlement of the solid matter, which is removed or dried by currents of air.

Improvements in apparatus to be used in disinfecting linen and bed-clothes, and the walls, ceilings, and floors of rooms, and for other like purposes. J. Teychenne, Birmingham, Warwick. April 13, 1875.—No. 1337. This invention consists of a pan or vessel, portable or fixed, divided by a vertical division into two compartments, on: compartment consisting of a closed vessel in which the disinfecting vapour or gas is volatilised or generated, and the other compartment consisting of an open vessel or chamber for receiving the linen or bed-clothes to be disinfected. The bottom of this chamber is charged with the disinfecting material, and the linen or clothes are laid upon a perforated partition. By the application of heat to the bottom of the apparatus the disinfecting material is volatilised in both chambers, and by the action of the vapour or gas directly generated in the clothes-chamber, and that conveyed to it under pressure from the other chamber, the clothes or linen are thoroughly disinfected. By means of a flexible pipe on the top of the closed vessel or chamber the disinfecting vapour or gas may be directed upon walls, ceilings, and floors of rooms, or other surfaces it is wished to disinfect.

A new method for removing the incrustation from boilers of steam engines, for prevention of successive incrustations, and for the preservation of the metal. V. Felice, Rome, Italy. April 14, 1875.—No. 1343. At the time steam is to be got up the following specific is to be introduced into the boiler through an aperture in its upper part. 1 kilo. of japan earth (that is to say, catechu); 50 grms. of sal ammoniac; 75 grms. of sumach, the whole forming the quantity for each ten horse-power engine.

Improvements in the purification of water and other fluids. T. Spencer, Euston Square, London. April 15, 1875.—No. 1368. The object of this invention is to consolidate granular magnetic carbide (used for the purification of water) into solid but porous magnetic blocks of any shape by treatment in an oven in mixture with flour, and then by increasing the heat to give the same coherence sufficient to render them applicable for portable and other filters. The means employed are also applicable to the consolidation of any ferruginous oxide or ferruginous refuse, and applicable to similar purposes.

Improvements in bleaching fabrics, yarns, fibres, paper pulp, and other articles. F. Wirth, Frankfurt-on-the-Main, Germany. (A communication from V. V. Baerle, Worms, Germany.) April 15, 1875.—No. 1382. I lay the article to be bleached first in a cold solution of silicate of soda. After the operation the stuff is pressed out. The material is then worked with cold water, and placed in a weak solution of chloride of lime. The stuff is bleached in weak hypochlorite of lime.

Improvements in the treatment of that preparation of india-rubber commonly called vulcanite. W. C. Henderson, Pownall Road, Dalston, Middlesex. April 17, 1875.—No. 1404. The object of the invention is to obtain various coloured effects in vulcanite. India-rubber is combined with colour to the depth of colour or tint desired, and to the combination obtained is added sulphur as may be required for the purpose of the conversion of the india-rubber, and having regard to

the action of the sulphur on the colour. The compound obtained is then cured and ground to reduce it into particles of the size required. These particles are then mixed with the dough of ordinary vulcanite in proportions varying with the effect desired to be produced, and then formed and cured. By these means effects are obtained very much resembling granite and other stones or marbles in appearance.

Improvements in the mode of and apparatus for treating fibres for the manufacture of paper. T. H. Gray, Grant Road, Clapham Junction, Surrey. April 17, 1875.—No. 1412. I cut up straw, bamboo, or other substances into lengths, say of 1 inch more or less, and subject the cut material to the action of rotating beaters contained in a fixed cylindrical case, armed at its periphery and at its sides with steel bars or blades. The materials are then submitted to a boiling process, with the addition of chemicals to reduce the fibres to pulp.

THE CHEMICAL NEWS

AND
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CONTENTS.

- I. On the Geological Age of the Deposits containing Flint Implements, at Hoxne, in Sussex, and the Relation that Palæolithic Man Bore to the Glacial Period. By Thomas Belt, F.G.S.
- II. A Scheme of Water Supply for Villages, Hamlets, and Country Parishes of the Central and Eastern Counties. By Prof. Hull M.A., F.R.S., F.G.S.
- III. Vivisection.
- IV. Infusorial Earth and its Uses.
- V. The Nizam Diamond—The Diamond in India. By Captain Richard P. Burton.
- VI. Certain Phases of Bird Life. By Charles C. Abbott, M.D.
- VII. The Loan Exhibition of Scientific Apparatus at South Kensington.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 872.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 45.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

THE use of Weldon's process is decidedly increasing. In the beginning of 1874 the annual produce in England on this system was 50,800,000 kilos. chloride of lime, and plant for the further production of an equal quantity was in the course of erection, whilst the previous annual production on the old system did not exceed 91,440,000 kilos. In Germany the "Silesia" establishment at Saarau has carried on Weldon's process with advantage for several years. In Belgium, according to Mr. Weldon's account, the works at St. Marie d'Oignies, near Charleroi, have introduced the process. In France the same step has been taken by the St. Gobain company, whilst Kuhlmann,† Merle, and other manufacturers are preparing to adopt the new method. In Saarau, where, as already mentioned, Weldon's process has been in operation for some years, it is carried on exactly as above described. The consumption of lime for the regeneration of material for 100 kilos. of chloride of lime is 70 to 75 kilos. inclusive of the sediment which becomes useless in preparing milk of lime. To regenerate enough for 2500 kilos. chloride of lime air is forced in for five to five and a half hours, and from 75 to 80 per cent of the manganese present is converted into peroxide. The air-pump employed works with 45 horse-power, and has a cylinder of 7'32 c.m. in diameter, and 9'16 in height. The piston makes 40 strokes per minute. The loss of peroxide of manganese at Saarau amounts to about 10 per cent (von Kulnitz).

The above-described process for the regeneration of manganese residues has one deficiency. A portion of the hydrochloric acid is used to saturate the lime of the calcium manganite, and both lime and hydrochloric acid are generally allowed to escape in the almost worthless state of chloride of calcium. To obviate this defect Weldon has planned a modification of his process which renders it practicable to obtain as much as 62 per cent of the hydrochloric acid employed in the form of free chlorine, whilst only a small quantity of chloride of calcium is formed as a by-product. He attains this result by decomposing the manganese solution not with lime, but with magnesia. For this purpose the process is modified as follows:—The liquid derived from the evolution of chlorine out of magnesium manganite, containing chloride of magnesium and manganese, is evaporated at first in a pan and then in a kind of muffle, whilst a current of air is constantly passed through. Towards the end of the evaporation the chloride of magnesium under the influence of watery vapour yields hydrochloric acid, which is condensed. After the liquid has been evaporated to a certain consistence the salts are drawn upon a hearth, where they are roasted in a current of air. Here chlorine is evolved, diluted with air, and is combined with milk of lime in a scrubber, whilst manganite of magnesium re-

mains behind. The latter is then used with hydrochloric acid for the development of chlorine, and passes again through the same rotation as a mixture of chlorides of magnesium and manganese. The hydrochloric acid, which is given off about the end of the evaporation, is exactly sufficient to evolve concentrated chlorine from the solution of chloride of lime, into which the diluted chlorine obtained by roasting the residue from the evaporation has been transformed. Hence only that part of the hydrochloric acid is lost which is consumed in decomposing the hypochlorite of lime, whilst 62 per cent of the chlorine which enters the process in the form of hydrochloric acid is utilised in the free state. In this manner it is possible to obtain 1000 kilos. chloride of lime with the hydrochloric acid evolved from 700 kilos. of common salt. The magnesia and manganic oxide are not consumed, but merely play the part of transferers of oxygen.

Preparation of Chlorine according to Deacon.—If Weldon has succeeded in preparing chlorine from hydrochloric acid in a continuous process without, theoretically at least, requiring more than one initial charge of native manganese, the problem of converting hydrochloric acid into free chlorine, without the formation of any by-products, has been much more completely solved by Deacon.

It has been long ago proposed to utilise for the manufacture of chlorine the well-known property of cupric chloride to be decomposed on heating into chlorine and cuprous oxide, which latter in a current of air yields copper oxychloride; but the experiment was never carried out on the large scale. The same applies to the fact, likewise long ago known, that hydrochloric acid mixed with air and passed over ignited porous bodies is partially converted into chlorine and water. Deacon has succeeded in founding upon the combination of both these reactions a process which enables us to obtain chlorine continuously without the formation of any troublesome residues whatsoever.

(To be continued.)

MINERAL PHOSPHATES AND SUPERPHOSPHATE OF LIME.*

By WALTER C. REID.

(Concluded from p. 50.)

German or Nassau Phosphate, deposited, like the Bordeaux variety, in pockets, is found chiefly in the neighbourhood of the rivers Lahn and Dill, in Nassau. Some of it is of a yellow colour, breaking with an earthy fracture; other portions have the appearance of pieces of phosphate, cemented together with ferruginous clay, and in rare cases it appears in a crystalline form. The richest varieties are of a light yellow colour, and tolerably free from iron, &c.; but the predominating lower qualities are contaminated with much iron ore, clay, limestone, &c.

Analysis of German Phosphates.

Triphosphate of lime	58 to 65 per cent.
Carbonate of lime	5 to 8 "
Iron and alumina	10 to 15 "
Insoluble matter	10 to 12 "

From these phosphates there is no difficulty in making superphosphate quite dry, but they invariably set extremely hard, and they therefore require much breaking up. Very few cargoes of German phosphates arrive in this country now.

Spanish and Portuguese Phosphorites generally go under the name of Estremadura phosphate, from the province in Spain where it is chiefly found. It is hard, of light yellow colour, crystalline structure, and generally more or less mixed with quartz, and becomes phosphorescent when heated. It is tolerably free from iron and alumina, but

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

† On September 18, 1874, I found in the establishment of M. Kuhlmann no preparations for the introduction of Weldon's process.—A. W. H.

* A Paper read before the Newcastle-upon-Tyne Chemical Society.

contains variable and often considerable quantities of fluoride of calcium.

The following are some analyses of Estremadura phosphate:—

	1.	2.	3.	4.
Triphosphate of lime..	72	78.7	72.6	80.6
Carbonate of lime ..	9	Nil.	Nil.	4.2
Iron and alumina ..	31	8.8	5.1	2.0
Fluoride of calcium ..	31			
Insoluble matter..	4	11.4	18.3	12.3

In dissolving, from 30 to 33 per cent of the phosphates in the superphosphates is rendered soluble; but, owing to the small quantity of carbonate of lime in the mineral, the superphosphates when first made are generally dense and damp, and require some time to get into good condition.

Norwegian and Canadian Phosphates.—Under the name of apatite, we import from Norway and Canada small quantities of phosphatic minerals, obtained from veins in the primitive rocks. They are hard and crystalline, of vitreous lustre, and of various shades of colour, white, yellowish white, and greenish white. According to Voelcker, the Norway apatite contains no fluoride of calcium, but the Canadian a great deal. Neither contain any carbonate of lime, and only a little iron and alumina. Some parcels have tested above 90 per cent of phosphate of lime, but on an average they do not exceed 75 per cent. The following analyses represent the best qualities:—

	Norway.	Canada.
Triphosphate of lime..	90.74	91.20
Iron and alumina ..	2.00	"
Fluoride of calcium ..	"	7.60
Sand, &c. ..	1.64	0.90
Chloride of calcium ..	1.61	0.78

The apatites are the only mineral phosphates that contain an appreciable quantity of chloride of calcium. In one kind, from Snarum, in Norway, the fluoride of calcium is, to a great extent, replaced by chloride of calcium, thus:—

Triphosphate of lime ..	91.13 per cent
Chloride of calcium ..	4.28 "
Fluoride of calcium ..	1.59 "

From apatites alone it is difficult to make dry and powdery superphosphates; but, by mixture with weaker phosphatic minerals that contain more carbonate of lime, they work very well indeed.

Guanos.—As non-nitrogenous guanos, we receive phosphatic materials from the West Indian Islands. These are called Sombrero, Navassa, Malden, and Curacoa, after the islets from which they are taken, and they are distinguished from the Peruvian, Mejellones, and Ichaboe kinds by the almost entire absence of ammonia, by the small quantity of organic matter, and by the large proportion of insoluble phosphates which they contain.

Sombrero rock or crust guano was at one time largely imported into England, but at the present time very little arrives in this country. It is quarried on Sombrero, one of the group of the Leeward Islands in the Caribbean Sea; an islet about two and a half miles long, three-quarters of a mile wide, and not more than 20 or 30 feet above the level of the sea, and which is entirely composed of this phosphatic substance. Fragments of bones are found in the rock, and it is supposed to be a breccia of bones of turtles and other marine vertebrata, coral debris, &c., collected before the elevation of the islet above the water, and cemented together since by the droppings of birds carried down through the mass by rains.

It varies in colour and texture, some being porous and friable, whilst other specimens are dense and compact. Recent importations have contained less iron and alumina and more carbonate of lime than formerly, and from this it is inferred that the rock (at present worked from under the sea) is mined in close proximity to the coral rock on which it rests.

Analyses of Sombrero Guano.

Triphosphate of lime ..	from 69	to 76	per cent
Carbonate of lime ..	"	2	to 4 "
Iron and alumina ..	"	7	to 10 "
Fluoride of calcium ..	"	1½	to 1½ "
Insoluble matter ..	"	1	to 2 "

When Sombrero guano is dissolved by itself, it makes a high grade superphosphate of a light yellow colour.

Navassa Guano, from the coral island of that name in the Caribbean Sea, is of a reddish brown colour, and consists of globular grains of phosphate of lime cemented into hard masses, and contaminated with a good deal of iron and alumina. It is found chiefly in the cavities of the rocks which form the framework of the island.

Triphosphate of lime ..	from 55	to 70	per cent
Carbonate of lime ..	"	4	to 6 "
Oxides of iron and alumina..	"	15	to 18 "
Iron and alumina (as phosphates) ..	"	8	to 10 "
Fluoride of calcium ..	"	1	to 2 "
Insoluble matter ..	"	4	to 5 "

Superphosphate of lime, when made from Navassa alone, is exceedingly hard and tough, and proportionately low in strength.

Curacoa and Malden Islands both furnish guanos, but they have lately been almost entirely sold on the Continent, where better prices seem to be obtainable. In these the phosphate of lime is in an unmineralised state, and in a fine state of division, they contain but little carbonate of lime, and are almost free from oxide of iron, alumina, and silicious matter. They range in quality from 65 to 80 per cent of tribasic phosphate of lime, the average being about 70 per cent. The lower qualities are, however, almost as valuable proportionately as the higher, in consequence of there being no oxide of iron, &c., to deteriorate the product, as in the case of most of the inferior phosphates, and they are capable of yielding superphosphates of high quality.

Conversion of Mineral Phosphates into Superphosphates.—It is scarcely necessary to remark that the phosphatic materials are mixed with sulphuric acid with the object of converting the unavailable natural phosphate of lime into a state to be assimilated by plants, and, if we assume that the acid acts upon all the ingredients simultaneously, we shall probably have the following decompositions:—

- (1.) Triphos. of lime + acid = biphos. of lime and sulphate of lime.
- (2.) Carb. of lime + acid = sulphate of lime and carbonic acid.
- (3.) Fluoride of calcium + acid = hydrofluoric acid and sulphate of lime.

- (4.) Oxides of iron and alumina + acid = sulphates of iron and alumina.

Sulphates of iron and alumina + biphos. of lime = $\left\{ \begin{array}{l} \text{Phosphates of iron, \&c.} \\ \text{Sulphate of lime.} \end{array} \right.$

There can be no doubt about the action of the acid the phosphates and carbonate of lime; nor can there be much doubt about the decomposition of the fluoride of calcium; for hydrofluoric acid and fluoride of silicium are shown to be in the evolved gases, first, by the fact that glass is etched when brought into contact with them; and secondly, by the depositing from them of pure gelatinous silica and hydrofluosilicic acid, resulting from the action of moisture upon the fluoride of silicium.

But, if the oxides of iron and alumina are converted into sulphates, it will not account for the gradual precipitation, or "going back" of some of the soluble portion of superphosphates, which continues for some time after being made.

If the acid is in sufficient quantity and powerful enough to decompose the fluoride of calcium, it seems strange that it should not also dissolve the iron and alumina; but the most probable way to account for "reduced phosphates," is to suppose, that, a portion at any rate, of

these remain as uncombined bases, to act as precipitants of the soluble phosphates.

After selecting a mineral by its chemical composition, the next thing is to consider its density or porosity, and the facility by which it can be reduced to a fine powder, and acted on by acid. It is impossible, in practice, to render the whole of the phosphate of lime soluble, and the proportion left undissolved, and depending upon the state of aggregation of the minerals, varies from 10 to 26 per cent of the total phosphates in the superphosphate.

In almost every case it is requisite to dry the phosphates before grinding, and to have powerful machinery to reduce them to powder. After drying they are crushed in mills or stone-breakers, then ground fine under French burr stones, and riddled. The quantity that can thus be prepared depends very much upon the hardness of the mineral, and the arrangement of the machinery and engine power; but a fair average quantity is 6 to 7 tons per mill per twelve hours. All the powder should be screened through wire gauze not less than 30 meshes to the inch.

The mixing or dissolving of phosphates in sulphuric acid is now almost entirely done by machinery. There are two kinds of mixing machines in use. One is vertical and made either of wood or metal with an upright spindle, to which are attached arms or wings for agitating, and wheel and pinion, &c., on top for turning same; the other kind consists of a long cylinder of metal or wood (or wood lined with lead) in which a stirrer revolves horizontally. Whether the mixers be vertical or horizontal they are always suspended over "Dens" (air-tight brick-built chambers), into which the superphosphate, when in a semi-fluid state, is allowed to run. The horizontal form of mixer is more generally in use, and 10 feet long by 2½ to 3 feet diameter is a convenient size, and will make about 6 tons of supers per hour. The ground materials and acid should be charged at one end, and the paddles or agitators should be so arranged as to work the mixture forward to the other end to be discharged.

It is advisable to feed the powdered phosphates into the mixing apparatus by means of elevators working by machinery, as in this way it is supplied much more regularly than when done by hand, and it is important that the supply of the two materials (phosphates and acid) should be at the same rate and finish together.

The acid employed should not be under 1.5 or above 1.6 sp. gr., and when new kinds of phosphates have to be dissolved, it is better to ascertain the quantity of acid that they will carry by a series of actual experiments with moderate sized batches rather than depend upon theoretical calculations based upon analysis of the mineral.

Some of the phosphates take their own weight of acid of 1.55 sp. gr., but the majority of them require rather less. It varies from 80 to 100 for each 100 of mineral. During the incorporation of the two materials irritating vapours are given off, and these are generally conveyed by a special flue to a condenser, or in some cases through a lime purifier, before being allowed to pass into the atmosphere. After remaining twenty-four to thirty-six hours in the "Dens," the superphosphate is taken out, and either stored for future or riddled for immediate use. If good, it should be light and porous, and easily crumbled.

ON RAPID FILTRATION.

By E. C. H. HILDEBRAND.

THOUGH much has been said and written on this subject, still it does not seem to be exhausted yet, not long ago new suggestions having been made in that direction. Viewing this matter from a practical standpoint, it appears to me that we should not aim so much at the utmost gain of time in filtering and washing out precipitates, but rather at a more uniform good result of these operations. In accordance with this view, the following described apparatus will be found both convenient and effective enough

to shorten the filtering process, and the drying of the filter and its contents quite considerably.

It is composed of Weil's filtering tube and Schiebler's drop aspirator, to which I have added a vacuum regulator. The filtering tube (recommended by Weil about sixteen or eighteen years ago) allows to filter under a pressure of 1 to 2 feet of water column, without any other support of the filter except the funnel itself. It allows, further, to filter into any kind of receptacle, which will be found a great convenience. On the other hand, Scheibler's drop aspirator, used as a filtering pump, is by far the most perfect one in reference to the effect produced by a given quantity of water, while its absolute effect is likewise very satisfactory for filtering purposes. The vacuum regulator is intended to prevent the rarefaction of air surpassing a certain degree.

Before entering into a more detailed description of the whole arrangement, it may be well to make a few remarks about funnels and filters.

It has been laid down, as a rule, that the sides of a funnel should have an angle of inclination of 60°, in which case a filter, folded at right angles, will fit exactly into the funnel. I found that a filter adjusted into a funnel of a more acute angle offers remarkably greater security against breaking, provided, of course, the body of the funnel approaches as nearly a perfect cone as possible. In this case the transition of the cone into the tube is marked by a distinct angle, formed by the meeting of two straight lines. The opening at the bottom of the funnel must not be too large, its diameter should not surpass ½ inch.

A filter inserted into a funnel of 50°, moistened and brought in perfect contact with the glass by pressing with the finger, will stand the pressure of a column of water 1½ feet high with safety. Filters supported by funnels of 30° did not rupture by the weight of a column of water 3 feet high. Funnels over 50° require the introduction of another but smaller paper filter, inside of which, and over-reaching it, the main filter is inserted.

1. *The filtering tube* (see sketch c) consists of a wider upper part, carrying the funnel, and a lower narrower part, reaching almost to the bottom of the receptacle, and dipping into the filtered liquid. By rarefaction of the air in c, the filtered liquid is raised to a certain height, and thereupon results an increased pressure on the liquid in the funnel, and an accelerated filtration. The total length of the tube is 20 inches, width of the upper part 1½ inches, its length 6 inches. The narrow side tube, m, is 1 inch below the rim of c; internal diameter of lower part ¼ inch, its length 14 inches. The lower part must be wide enough to allow air bubbles to rise or overcome the capillary attraction exerted by the sides of the tube upon the liquid. The tube is closed by a perforated india-rubber cork, receiving the neck of the funnel, the opening of which reaches 1 or 2 inches below the little side-tube m. The whole is held in position by a retort-stand, burette-holder, or the like.

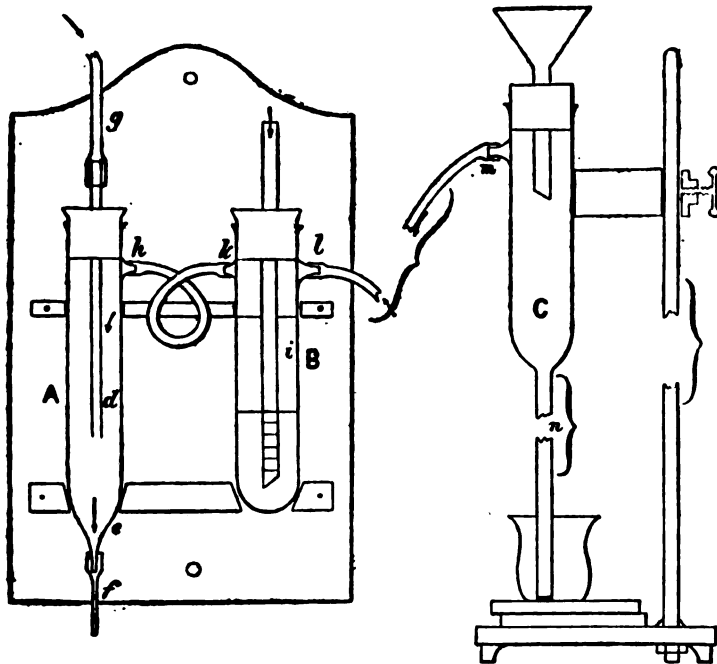
2. *The Aspirator A.*—Upper part 1 inch in diameter and 6 inches long, the bottom forming a cone, connecting it with the lower part, e, which has ½ inch internal diameter, and is 1 or more inches long. To this we attach a rubber tube, f, 5 or more feet long, and of the same internal diameter of ½ inch. The narrow side-tube, h, is 1 inch below the top of A. A perforated rubber cork, provided with a glass tube, d, is inserted, as seen in the sketch. This tube has ⅜ inch internal diameter, extends downwards about 3 inches, upward 1 or 2 inches. To this upper end a rubber tube, g, is attached, destined to supply the water for the aspirator from an elevated vessel. If the flow of the water is so regulated (by means of a faucet or pinchcock) that it leaves tube d drop by drop, these drops falling into the narrow tube, e, and its continuation, f, perpendicularly beneath it, and, filling out its entire width, act the part of the piston in a pump, as by their motion downwards they carry with them the air enclosed in the tube between the single drops. In this way the air in A, as well as in any vessel connected with it by the communication-tube, h, is rarefied. The aspirator—equa

lengths of time taken into consideration—draws less air if the drops follow each other slower, but then a higher effect is produced by a certain quantity of water, whilst if the drops fall quicker the apparatus draws more air in that time, but the effect of the same quantity of water is diminished. Thus, 1 volume of water draws from 10 to 25 times its volume of air.

3. *The Vacuum Regulator B.*—After several experiments, I found a mercury valve of the construction shown in sketch B, working as well as could be wished. B has $1\frac{1}{2}$ inches or more internal diameter, and is about 6 inches long. The narrow side-tubes, *k* and *l*, are opposite each other, and 1 inch below the rim. A good soft cork, free from holes, is selected and perforated for the reception of tube *i*. The latter has about $\frac{1}{4}$ inch internal diameter, by inches in length. Its lower end is cut off obliquely, and provided with mark showing $\frac{1}{2}$ inches, and beginning at

If this apparatus is to be constructed out of material on hand in every laboratory, we may take a chloride of calcium tube for the aspirator (Scheibler), and a large test-tube, or any wide-mouthed bottle, for the regulator, in which case the communication of the single parts is brought about by perforations in the corks.

In case it should be preferred to make use of Bunsen's platinum funnels, we can proceed a little different from Bunsen's method, as such an exact fit as needed in high pressure is not wanted in our case. Divide a round piece of moderately thin platinum foil, about $1\frac{1}{4}$ inches in diameter, into two equal halves, and shape them into cones, the centre of the circle forming the apex of the cone. In funnels of less than 60° the sides overlap; in funnels of 60° they meet exactly, but can even then be soldered together in one point about the middle of the cone by a grain of gold and a little borax. I cut off the point of the cone to



the obtuse angle of the oblique cut. Tube *B* is filled up with mercury to a height of about 2 inches, then 2 inches of water are given on the top of this. The working of this valve is easily understood. By moving tube *i* downwards or upwards, its lower end is, to a larger or smaller extent, immersed in the quicksilver, and if suction is applied to one of the side tubes, the other being connected with a closed vessel, the rarefaction of air in *B*, and in the vessel connected with it, will reach a certain maximum degree, beyond which it cannot go: air entering by way of tube *i*, and penetrating the mercury, it maintains that status in the apparatus to which the valve has been adjusted. If the end of tube *i* is cut off obliquely, as directed, the passage of the air through the quicksilver goes on more quiet, not so eruption-like, and the supernatant water prevents entirely the spattering of the metal. Several physical causes unite to give the graduation on tube *i* only an empirical value. Under the circumstances named, $\frac{3}{4}$ inch immersion of tube *i* will create in *C* a water-column of about 15 inches height.

4. *The connection of the single parts* is effected by rubber tubing, which need not be of the heaviest kind, as it is not exposed to any high external pressure. Aspirator and mercury valve are best mounted on a board (as seen in the sketch), and hung in a proper place on the wall within each of the hand.

create a small opening there, as I also perforate the sides of the cone near its apex with a pin.

Before leaving this subject I will mention, with a few words, a most simple device which I have frequently used to promote filtration, and which consists of a piece of rubber or glass tubing, about 1 foot long, fastened into the tube of the funnel when the arrangement is ready for use. The internal diameter of this tube should be, at the most, $\frac{1}{2}$ of an inch. A tube similar in shape to Weil's filtering-tube, but of different dimensions, looks more elegant, and meets the objection against bringing the filtered liquid in contact with india-rubber. The upper wider part is 3 inches long; the lower narrow part is made of a barometer-tube, and of the length first named. This little device meets moderate expectations very well, and will often be found a good help.

For washing out precipitates on a larger scale I use large funnels, half filled with coarse glass-powder (glass heated to redness, thrown into cold water, powdered, and the finest powder sifted off), on the evened surface of which is placed a round piece of filtering paper, in close contact with the sides of the funnel, for the reception of the precipitate. As a receptacle I use a Woolf's bottle of proper size; the filtering-pump has an evacuation-tube of 12 feet length.—*American Journal of Pharmacy.*

"THE BOOK OF THE BALANCE OF WISDOM."

By H. CARRINGTON BOLTON, Ph.D.

THIS work is an Arabic treatise on the water-balance, written in the twelfth century, for an account of which the historian of science is indebted to the Chevalier N. Khanikoff, sometime Russian Consul General at Tabriz, an important city of Northern Persia. M. Khanikoff having obtained access, in some manner not explained, to a manuscript copy of the Arabic work, translated into the French language copious extracts, and prepared an analysis of its contents; these data, together with a transcript of the original Arabic version, he communicated to the American Oriental Society. The Society's Committee of Publication, in preparing the Russian Consul's work for their *Journal*, translated his notes into English, re-translated the Arabic extracts, and added their own valuable comments. The completed article is found in the sixth volume of the *Journal of the American Oriental Society*, pp. 1 to 128, published in 1859.

"The Book of the Balance of Wisdom" treats exclusively of the balance and of the results attainable by this instrument, which has given to modern science so many beautiful discoveries. Its exposition of the principles of the centres of gravity, of researches into the specific gravity of metals, precious stones, and liquids, shows these Orientals to have attained to experimentation, a step in the progressive knowledge of physical truths entirely unknown to the ancients.

The dedication of the work proves it to have been composed at the court of the Saljuke Sultan Sanjar who reigned over a large part of the ancient Caliphate of Bagdad from A.D. 1117 to 1157. In this introduction, the author appeals to this potentate in the following fulsome expressions of homage characteristic of the Orientals:—

"Most magnificent Sultan, the exalted Shah of Shahs, the king of subject nations, the chief of the Sultans of the world, the Sultan of God's earth . . . the shelter of Islamism and of Muslims, the arm of victorious power . . . Prince of Believers—may God perpetuate his reign and double his power! For his felicity is the illuminating sun of the world, and his justice its vivifying breath."

And immediately following this passage occurs mention of the date:—

"I sought assistance from his beams of light irradiating all quarters of the world, and was thereby guided to the extent of my power of accomplishment in this work, and composed a Book on the Balance of Wisdom for his high treasury, during the months of the year 515 of the Hegira of our Elect Prophet Mohammed—may the benedictions of God rest upon him and his family, and may he have peace!"

This proves the treatise to have been written in the years 1121—1122, A.D.

The authorship of the "Book of the Balance of Wisdom" is easily determined by the fortunate circumstance that the author names himself several times, "but in so modest a manner as scarcely to attract attention; instead of heralding himself at once, in his first words, after the usual expressions of religious faith, as Arab authors are wont to do, he begins his treatise by discoursing on the general idea of the balance," and then simply remarks: "*Says al-Khazini, after speaking of the balance in general,*" and proceeds to enumerate the advantages of the balance which he is about to describe. Two other passages in the extracts furnished by M. Khanikoff satisfy the Oriental scholars who have examined them that the author is this self-named al-Khazini.

Attempts to identify al-Khazini with individuals of historical fame have given rise to differences of opinion, but the weight of evidence is in favour of regarding him as the same with Alhazen, the Arab optician and physiologist.

Alhazen seems to have been a native of Persia and to have resided in Spain and Egypt, but of his biography little is known. He is especially distinguished for his demonstration of the theory of vision, showing that the rays of light are reflected from external objects to the eye and do not issue forth from the eye to impinge on external things, as up to his time had been taught.

This explanation, moreover, was not based on mere hypothesis, but was the result of anatomical investigations as well as of mathematical discussions.

Alhazen also explained the astronomical refraction of light, its dependence on the variation of the density of the media traversed, and its influence in producing the phenomenon of twilight. In the discussion of all these problems he evinced true scientific greatness. He favoured the theory of the progressive development of animal forms, anticipating a doctrine but newly obtaining acceptance. Dr. J. W. Draper,* who has been our guide in this connection, says of Alhazen: "Though more than seven centuries part him from our times, the physiologists of this age may accept him as their compeer."

The name al-Khazini signifies, "related to the treasurer," which accords with his statement that the work was composed for the royal treasury.

The "Book of the Balance of Wisdom" begins with a dedication to God "the compassionate, the merciful," and a pious statement of the author's religious faith. An introduction, divided into eight sections, then follows; in the first section, the advantages and uses of the balance are enumerated in this language:—

"These advantages are:—1. Exactness in weighing; this balance shows variations to the extent of a mithkal, or of a grain, although the entire weight is a thousand mithkals, provided the maker has a delicate hand, attends to the minute details of the mechanism, and understands it. 2. That it distinguishes pure metal from its counterfeit, each being recognised by itself without any refining. 3. That it leads to a knowledge of the constituents of a metallic body without separation one from another. . . . 4. That it shows the superiority in weight of one of two metals over the other in water, when their weight in air is the same, and reversely. . . . 5. That it makes the substance of the thing weighed to be known by its weight. . . . 6. . . . 7. The gain above all others—that it enables one to know what is a genuine precious stone, such as a hyacinth, or ruby, or emerald, or fine pearl; for it truly discriminates between these and their imitations or similitudes in colour, made to deceive."

Then follows the theory of the water balance; and in the fourth section some account of its early history and the well-known narrative of King Hiero's crown.

In the third lecture of the "Book of the Balance of Wisdom" al-Khazini describes a form of specific gravity flask, which he calls the "conical instrument of Abu-r-Raihan," and to whom he apparently ascribes the invention.

Abu-r-Raihan was a distinguished Arabian astronomer, born about 970, and died 1038, A.D. He was a member of the Society of Savans founded in the capital of Kharism, and of which the eminent physician Avicenna was a shining light. He was the author of a number of works on astronomy, cosmography, and physics, one of which, entitled "The Book of the Best Things for the Knowledge of Mineral Substances," and contained in the *Ayin-Akbari*, or *Institutes of the Emperor Akbar*, treats of the specific gravity of bodies and of hydrostatic methods for determining them.

The author remarks that "the instrument is very difficult to manage, since, very often, the water remains suspended in the lateral tube, dropping from it little by little into the scale of the balance." This passage shows that Abu-r-Raihan had noticed capillary attraction; it is also certain that he understood that the size of the neck of the instrument affected the delicacy of the determinations, for

* Abstract of a paper read before the New York Academy of Sciences, May 29, 1876, and reported in the *American Chemist*.

* *Hist. Int. Devel. Europe*, p. 360.

he says he would have it "made narrower than the little finger but for the difficulty of removing through a smaller tube the bodies immersed in the water."

Al-Khazini's work is made up of eight lectures, each lecture includes several chapters, and each chapter has several sections; we quote al-Khazini's own summary of his treatise as contained in the sixth section of the introduction.

"I have divided the book into three parts: I. General and fundamental topics, such as heaviness and lightness; centres of gravity; the proportion of the submergence of ships in water; diversity of the causes of weight; mechanism of the balance and the steelyard; mode of weighing with it in air and in liquids; the instrument for measuring liquids, in order to ascertain which is the lighter and which is the heavier of the two, without resort to counterpoises; knowledge of the relations between different metals and precious stones in respect to [given] volume; sayings of ancient and modern philosophers with regard to the water balance, and their intimations on the subject. This part includes four lectures of the book in their order. II. Mechanism of the balance of wisdom; trial of it; fixing upon it of [the points indicating] the specific gravities of metals and precious stones; adoption of counterpoises suited to it; application of it to the verification of metal, and distinguishing of one from another [in a compound] without melting or refining, in a manner applicable to all balances; recognition of precious stones and distinction of the genuine from their imitations or similitudes in colour. There are here added chapters on exchange and the mint, in connection with the mode of proceeding, in general, as to things saleable and legal tenders. This part embraces three lectures. III. Novelty and elegant contrivances in the way of balances such as: the balance for weighing dirhams and dinars without resort to counterpoises; the balance for levelling the earth to the plane of the horizon; the balance known as the 'even balance' which weighs from a grain to a thousand hirhams or dinars by means of three pomegranate counterpoises; and the hour balance, which makes known the passing hours, whether of the night or of the day, and their fractions in minutes and seconds, and the exact correspondence therewith of the ascendant star and fractions of a degree. This part is in one lecture."

In the seventh chapter, which treats of the "Mechanism of the Instrument for Measuring Liquids . . . and Application of it according to the Philosopher Pappus, the Greek," we find a description of a hydrometer.

"The length of this instrument, which is cylindrical in shape, measures half a hand-cubit; and the breadth is equal to that of two fingers, or less. It is made of brass, is hollow, not solid, and the lighter particles of brass are carefully turned off by the lathe. It has two bases, at its two ends, resembling two light drum-skins, each fitted to the end, carefully, with the most exact workmanship; and on the inner plane of one of the two bases is a piece of tin, carefully fitted to that plane by the lathe, shaped like a funnel, the base of which is the drum-skin itself. The instrument being thus made, when put into liquid in a reservoir or vessel, it stands upon it in an erect position and does not incline anyway."

The author then describes at length the manner of graduating the instrument, the decimal system being employed throughout. He remarks that the weight of the funnel shaped piece of tin must be varied according to the density of the water assumed as a standard. Tables of the specific gravities corresponding to the marks on the instrument accompany the detailed account of its application.

It is evident that Pappus's instrument resembled closely that of Gay-Lussac. It was, however, provided with two scales, one with its numbers increasing upwards to indicate the volume submerged in liquids of different density; the other with its numbers increasing downwards, to show the specific gravities corresponding to those submerged volumes.

The above-mentioned Pappus was an eminent Greek geometer of Alexandria, who flourished about 380 or 400, A.D. Consequently he was a contemporary of Synesius, of Cyrene (378-430, A.D.), in one of whose letters occurs what is ordinarily regarded as the first recorded mention of the hydrometer. It is certainly most interesting to find that al-Khazini's description of Pappus's instrument corresponds very closely with the statements of Synesius, a coincidence not observed by previous writers.

Synesius, "the good bishop of Ptolemais," writing to his instructress, "the fair pagan philosopher and mathematician, the ill-fated Hypatia, and being desirous of trying the wines† he is using, says:—

"My health is so delicate that I need a *hydroscope*, and I beg you to have one made for me of copper. It is a tube cylindrical in shape and of the form and size of a pipe; on its length it bears a straight line crossed by small lines, by means of which we determine the weight of waters. One end is terminated by a cone, arranged in such a manner that the tube and the cone have the same base. This instrument is called *baryllion*. If you place it in water, point downwards, it stands erect, and the divisions that cross the vertical line can be easily counted, and by this means the density of water is determined.‡"

Hoefler, the French Historian of Chemistry, in relating this statement, remarks that none of the commentators of the Letters of Synesius were able to explain the nature of this instrument until the mathematician Fermat, in answer to Castelli's request, communicated his view, correctly apprehending the principles and uses of the instrument described. This was in 1628, and now we learn that the Arabian philosophers five centuries earlier were perfectly familiar with the identical instrument mentioned by Synesius.

Al-Khazini describes several forms of balances at great length, giving details of construction and employment. One of these balances he ascribes to Archimedes; and he professes to quote the particulars respecting it from Menelaus, without, however, giving the title of the latter's work.

Another balance described by our author is that of Muhammed Bin Zakariya, of Rai; it differs from that of Archimedes by the introduction of the needle, called by the Arabs the "tongue," and by the substitution of a movable suspended bowl for the movable weight.

Finally, in the fifth lecture, he gives a minute description of the balance of wisdom according to Abu-Hatim al-Muzaffar Bin Ismail, of Isfazar. "He begins by remarking that the balance being an instrument of precision, like astronomical instruments such as the astrolabe and the zijassafai, its whole workmanship should be carefully attended to. He next describes the beam, the front piece, the two 'cheeks' between which the 'tongue' moves, and the tongue itself." He gives the length of the beam as four bazaar cubits (two meters) and remarks that "length of the beam influences the sensibility of the instrument;" it is constructed of iron or bronze. The balance is provided with five bowls or pans, made of very thin plates of bronze, three of which have the form of hemispheres, one of which is spherical and the remaining one, destined to be plunged into water, is finished with a conical bottom. Two of these bowls bore the name of the "aërial" and were permanently attached to the beam; another pan was movable on the right arm of the beam; and the bowl intended to be immersed in water was fastened underneath the aërial bowl of the left arm; this bowl bore the name of the "aquatic," and the spherical bowl was named the "winged."

He also speaks of the mode of adjusting the balance, and of its application to the examination of metals and of

* Not in a letter of Hypatia to Synesius, as Hoefler has it in his "Hist. Physique," Paris, 1872, 12mo.

† Draper, "Hist. Int. Devel. Europe."

‡ Synesius, "Opera. Epist. XV., Lutetia," 1612, 4to, p. 174.

precious stones. Al-Khazini distinctly states that in taking the specific gravity of bodies he employed "a determined sort of water similar in density to the water of the Jaihun of Khuwarazm," and further that "we made all our comparisons in one single corner of the earth, namely, in Jurjaniyah [a city], of Khuwarazm . . . and early in the autumnal season of the year." The "Jaihun" is the modern river Oxus, and "Khuwarazm" corresponds to the modern province of Khiva.

The editor, M. Khanikoff, calls special attention to the following passages, which he considers the most remarkable in the whole treatise:—

"When a heavy body of whatever substance is transferred from a rarer to a denser air it becomes lighter in weight, from a denser to a rarer air it becomes heavier." (Lect. I., Chap. v., sec. 1.)

"Air-weight does not apparently vary, although there is actual variation, owing to difference of atmospheres. As regards its water-weight, a body visibly changes, according to the difference between waters of [different] regions, wells, and reservoirs, in respect to rarity and density, together with the incidental difference due to the variety of seasons and uses. So then the water of some determined region and known city is selected, and we observe upon the water-weight of the body, noting exactly what it is, relatively to the weight of one hundred mithkals; and we refer [all] operations to that [result as a standard], and keep it in mind against the time when we are called upon to perform them, if the Supreme God so wills. In winter one must operate with tepid, not very cold water, on account of the inspissation and opposition to gravity of the latter, in consequence of which the water-weight of the body [weighed in it] comes out less than it is found to be in summer. This is the reason why the water bowl settles down when the water has just the right degree of coldness, and is in slow motion, while, in case it is hot and moving quickly, or of a lower temperature, yet warmer than it should be, the bowl does not settle down as when the water is tepid. *The temperature of water is plainly indicated both in winter and summer; let these particulars therefore be kept in mind.*" (Lect. V., Chap. vi., sec. 5.)

An examination of these extracts compels a belief that the Arabian philosophers of the twelfth century knew the air to have weight, though they never applied the means they had discovered of measuring it. The sentence in italics leads to the conjecture that they also had some means of determining the temperature of water; possibly a form of aerometer was the instrument employed, and they were thus enabled to recognise the fact that the density of water increases in proportion to its coldness.

Al-Khazini's work contains several tables of the specific gravities of substances determined either by the "Balance of Wisdom" or by the hydrometer of Pappus. In these tables are enumerated fifty substances, nine of which are metals, ten precious stones, thirteen materials of which models were made, and eighteen liquids.

It is interesting to learn that the Arabian physicists fully appreciated the necessity of operating on pure materials and the advantages of averaging the results of many determinations. Thus, Al-Khazini says he purified gold by melting it five times, after which it melted with difficulty, solidified rapidly, and left hardly any trace upon the touchstone; and, after ten trials to obtain the weight of the volume of water displaced by different weights of the gold, he found, for a hundred mithkals of gold, weights varying from 5 mithkals 1 danik and 1 tassuj to 5 mithkals 2 daniks; as mean weight he adopts 5 mithkals 1 danik 2 tassuj.

Likewise mercury was purified by passing it repeatedly through many folds of linen cloth. In writing of mercury he remarks that it is not, properly speaking, a metal, but it is "the mother of the metals, as sulphur is their father." This view of the nature of mercury was prevalent among Arabian chemists, and is found in the writings of Geber (or Djafar), who lived four centuries earlier.

Geber writes of mercury, "It is also (as some say) the matter of metals with sulphur,"* and he does not place it in the same class with metals which he defines as "extensible under the hammer," a property not possessed by mercury under ordinary conditions.

In this conception of al-Khazini we find, moreover, the germs of the doctrine of the transmutation of metals, the basis of that alchemical pseudo-science which subsequently acquired such a wonderful influence over the human race. For if metals have mercury for a mother and sulphur for a father, they are not simple substances, and if compounds they are capable of artificial preparation and mutual transformation. This is, however, not the only passage containing allusions to a belief in transmutation, though no mention occurs of any practical attempts to effect it. The following extract clearly refers to the compound nature of metals:—

"When the common people hear from natural philosophers that gold is the most equal of bodies, and the one which has attained to perfection of maturity, at the goal of competition in respect to equilibrium, they firmly believe that it is something which has gradually come to that perfection by passing through the forms of all [other metallic] bodies, so that its gold nature was originally lead, afterwards became tin, then brass, then silver, and finally reached the perfection of gold."

Al-Khazini gives detailed accounts of the precious stones, of which we quote a few brief extracts. He says—"Emerald and chrysolite are interchangeable names, whether applied to one and the same thing, or to two things of which one has no real existence," a passage which shows that mineralogical terminology was afflicted with superfluous synonyms at an early day. Of the cornelian he says—"Men have long tired of the cornelian, so that it has ceased to be used as a stone for seal-rings; even for the hands of common people, to say nothing of the great." Of the "fine pearl" he writes—"The pearl is not a stone at all, but only the bone of an animal, and not homogeneous in its parts." "Coral," he writes, "is a plant, though petrified like the Jew's stone and the sea-crab." He is aware that "glass is not the product of a mine, but, on the contrary, kindred to stones, or sand, or alkali," and he states that he has included it in the list "because it resembles crystal."

Besides these contributions to the knowledge of specific gravities, al-Khazini devotes some attention to certain subjects not closely connected with the main theme. In the third lecture he attempts to calculate the quantity of gold which would compose a sphere equal to the globe of the earth, and arrives at a number of mithkals which requires for expression 29 digits.

In the same lecture he takes up the problem of the chess-board, of which he supposes the squares to be filled with dirhams, each square containing twice the number in the preceding; he finds the total number of dirhams to be 18,446,744,073,709,551,615. He then applies himself to ascertaining the dimensions of the treasury in which the treasure should be deposited, and finally quotes the lines of an Arabian poet which fix the time in which one might spend this sum at 200,000,000,000,000 years.

In the last lecture he describes the methods of applying the balance to levelling and to the measuring of time. Of this portion M. Khanikoff gives the following concise exposition:—

"The balance level consists of a long lever, to the two ends of which were attached two fine silken cords, turning on an axis fixed at a point a little above its centre of gravity, and suspended between two sight-pieces of wood, graduated. At the moment when the lever became horizontal the cords were drawn in a horizontal direction, without deranging its equilibrium, and the divisions of the scales of the sight-pieces corresponding to the points where the cords touched them were noted. For levelling plane surfaces use was made of a pyramid with an equilateral triangular base, and hollow and open to the light

* Geber, "Sum of Perfection," Book I., part iii., chap. 6.

from the summit of which hung a thread ending with a heavy point. The base of the pyramid thus arranged was applied to the plane which was to be levelled, and carried over this plane in all directions. Wherever the plane ceased to be horizontal the joint deviated from the centre of the base.

"The balance-clock consisted of a long lever suspended similarly to the balance-level. To one of its arms was attached a reservoir of water, which, by means of a small hole perforated on the bottom of it, emptied itself in twenty-four hours. This reservoir, being filled with water, was poised by weights attached to the other arm of the lever, and in proportion as the water flowed from it the arm bearing it was lifted, the weights on the other arm slid down, and by their distance from the centre of suspension indicated the time which had elapsed."

Many points of interest, demanding at least a passing notice, may be embodied in a summary of the principal propositions contained in this treatise:—

1. The "Book of the Balance of Wisdom" shows the Arabian philosophers of the twelfth century to have entertained advanced views regarding attraction. They recognised gravity as a force, and attributed to it a direction towards the centre of the earth; they also knew that it diminishes with the distance, but they erroneously supposed this diminution to be in the direct ratio of the distance, and not as its square.
2. They were acquainted with the connection between the weight of the atmosphere and its increasing density, since mention is made of the loss of weight of a body weighed in a denser atmosphere.
3. They understood the theory of centre of gravity, and applied it to the investigation and construction of balance and steelyards.
4. They made frequent use of the hydrometer, which they inherited from antiquity, and possibly they employed this instrument as a thermometer for distinguishing by variations of density the different temperatures of liquids.
5. They observed the action of capillary attraction.
6. They compiled full and accurate tables of the specific gravities of most of the solids and liquids with which they were acquainted.
7. Their system of philosophy was founded on experiment and observation.

In conclusion we quote the following appropriate remarks from M. Khanikoff's introduction:—

"The history of the sciences presents to us an incontestable fact of deep significance—the re-discovery in modern times of truths laboriously established of old; and this fact is of itself enough to indicate the necessity of searching carefully in the scientific heritage of the past after all that it may be able to furnish us for the increase of our actual knowledge; for a double discovery, necessarily requiring a double effort of human intellect, is an evident waste of that creative force which causes the advance of humanity in the glorious path of civilisation."

CORRESPONDENCE.

ORGANISATION AMONG CHEMISTS.

To the Editor of the Chemical News.

SIR,—My letter to you of the 6th June last, published in the *CHEMICAL NEWS* (vol. xxxiii., p. 240), has led to some persons, interested in the establishment of the proposed Institute, addressing communications to me, in some cases seeking for information as to the details of the scheme and promising both moral and financial support, and in other cases making suggestions with a view to my clients' scheme being made more perfect in its details.

In all cases I find a strong feeling prevailing amongst chemists of character and position as to the necessity for vigorous steps being taken to raise the status of persons adopting chemistry as a profession; and now that what has for a long time past seemed to be idle talk, or the dreams of visionaries, is assuming a form, and showing the elements of vitality, a lively interest is displayed by many who are desirous that as soon as practicable the Institute should be established and its important work commenced.

Questions are, however, from time to time raised as to the persons to be admitted to membership, and the manner of their election. Your readers may rest assured that these questions have already received full consideration on the part of the active promoters of the scheme.

The qualifications of the several classes of persons, and the conditions upon which they were to be received into the membership, as stated in my letter to you (*CHEMICAL NEWS*, vol. xxxiii., p. 240), were not agreed to before objections thereto had been anticipated, and in consultation between some of my clients and myself fully discussed. It was felt that under all circumstances the regulations upon this point recommended by my clients would in actual working prove to be conducive to the success of the Institute, and as valuable in promoting its objects as any that could be devised. It was not, however, expected that all chemists would at once accept this part of my clients' scheme, but although alterations therein have been suggested to me I still consider that my clients' proposals are the best, and when fully understood will prove the most acceptable.

It is objected that inasmuch as all persons who have "practised on their own account in the profession of a consulting or analytical chemist for a period of five years" are to be eligible for election without producing evidence of training and fitness or undergoing an examination to prove such fitness, that "high" and "low" analysts and quacks will not be excluded from membership, and that the principal object of the Institute will thus be lost. To guard as far as practicable against the admission of incompetent or disreputable men it is intended that every person proposed for election should be nominated by five persons having personal acquaintance with the candidate, that his name and the names of his nominators (after being submitted to the Council), and the date of his election should be communicated by post to each member of the Institute fourteen days before the date of election, and that at the ballot four-fifths of the members present must vote in the candidate's favour to secure his election. If the members do their duty, and act in a spirit of high honour in the observance of these regulations it is thought that improper persons will be kept out of the Institute but should any such person become a member, the power of expelling therefrom, upon proof of unworthy conduct, will, if the members are true to the principles governing the Institute, be sufficient to ensure that all persons wearing the dignity of membership shall be honourable and trustworthy men.

It has been suggested that "works" chemists should be entitled to become candidates for election on the same conditions as persons "who have practised as chemists on their own account for at least five years," and consequently without affording the evidence of training and employment as proposed in my letter of the 6th of June last, under the heading, "As to persons not now employed as chemists." Works' chemists are in many cases highly trained, able, and conscientious men, and in such cases difficulty will not be experienced in their establishing their qualifications and fitness for admission into the Institute. But it is, I believe, an acknowledged fact that many "works" chemists are ill trained, and, except as to their own particular branch of chemical manufacture, are, in many cases, ignorant of the simplest principles of chemistry as a science, and beyond the circle of their own employment are quite unknown, and certainly have no public (and, outside the scene of

their employment, any scientific reputation. The Institute would undoubtedly suffer if all "works" chemists were indiscriminately admitted to membership without producing evidence of training and subsequent employment. As in the varied walks in life the innocent are required to suffer for the guilty, so in the case of the Institute, the competent "works" chemist will have to prove his distinction from the incompetent servant, but having done this the honour of membership will be more clearly brought out, and be more thoroughly appreciated.

It is obvious that in practice it would be found impossible for the Council of the Institute to enforce any rule requiring candidates "now practising as chemists on their own account" to bring evidence of their training and fitness, and the Council could not make selections amongst that class of persons, requiring some to bring such evidence and permitting others to come without it. They would place themselves in a most invidious position were they to attempt to do so.

As it is understood the Chemical Society is now advised that it cannot alter, or add to, its name, or sanction the creation of an Institute which shall be an adjunct to the Society, and in fact form a part thereof, it is desirable that the question of the establishment and the government of the Institute should now be taken earnestly in hand, so that an unnecessary delay may not occur after the recess in making the organisation complete.

I shall receive with much pleasure any suggestions from your readers upon this important and interesting subject.—I am, &c.,

J. PETTENGILL.

32, Walbrook, London, E.C.
August 3, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 2, July 10, 1876.

Note on a Communication by M. Sacc, entitled "On Panification in the United States, and on the Hop as a Ferment."—M. L. Pasteur.—The author maintains, in opposition to M. Sacc, that the hop does not contain a soluble alcoholic ferment.

Objections to the Last Communication of M. Hirn on the Maximum Possible Repulsive Pressure of the Solar Rays.—M. A. Ledieu.—The author, like M. Hirn, admits the excellence of the application of the method of successive elimination to the study of the cause of motion in the radiometer of Mr. Crookes; but an erroneous employment of this method only introduces a new element of complication into a question so delicate in itself. The numbers 0.0004157 grm. and 0.0008314 grm., proposed by M. Hirn to represent the maximum possible repulsion of light per square metre, whether for a blackened surface or for one perfectly polished, have no acceptable signification. M. Hirn assumes that the speed of the impact of the molecules striking the discs is no other than the speed of light itself, whilst in the hypothetical collision in question we must evidently consider the vibratory speed of the said molecules. But this latter velocity has nothing in common with the rapidity of propagation of the light-waves.

Experimental Researches on Magnetic Rotatory Polarisation (Third Part: Dispersion of the Planes of Polarisation of the Luminous Rays of Different Lengths of Waves).—M. H. Becquerel.—Unsuitable for abstraction.

Cellulosic Fermentation of Cane-Sugar.—M. E. Durin.—Cane sugar is split up into equivalent weights of cellulose and levulose under the influence of a special

ferment. The ferment which determines this transformation is of a diastasic nature.

Difference of the Potential Presented, after Rupture of the Inductor Current, by the Isolated Extremities of an Open Induction Coil.—A mathematical paper, not suitable for abstraction.

Reactions of Chlorine under the Influence of Porous Carbon.—M. Melsens.—With reference to the paper of M. Damoiseau, read at the last meeting of the Academy, the author urges that the influence of porous carbon upon gases is already well known to physicists and chemists.

A New Butylic Glycol.—M. Milan-Nevole.—The author describes in this paper the products obtained by the oxidation of his glycol.

Explanation of the Impressionability of the Blackened Discs of the Radiometer by the Aid of the Emission Theory, according to J. B. Biot.—M. W. de Fonvielle.—J. B. Biot, in the third volume of his "Traité de Physique," explains how the luminous molecules cannot communicate their *vis viva* to reflecting surfaces. In fact, these latter exert a truly repulsive action upon those molecules which, not touching them, cannot produce upon them any percussion similar to that impressed by electric forces. The considerations developed by this illustrious physicist not being applicable to blackened discs, we understand that the rotation of the radiometer should be produced in such a direction that they may fly from the ray. Is it not curious to find that the emission theory has permitted us to some extent, as far back as 1816, to foresee the experiment of Mr. Crookes? The explanation of the phenomenon, if we admit M. Biot's starting-point, does not require any new reasoning. The effort lost in the change of direction of the luminous molecules seems at first sight not to produce any effect, a result which does not appear reconcilable with the law of the conservation of the quantity of movement. Nevertheless, we may reply to this objection that according to the theory of emission this quantity of motion is represented by an internal ray performed upon the ray of light; for the direction of the axis of the luminous molecules has been changed since the reflection, for in place of being situated in the direction of the ray these axes have become perpendicular to that direction after the reflection. In this hypothesis the energy destroyed is represented by that which has been employed for the polarisation of the incident ray. The author has studied, along with M. Ruhmkorff, an apparatus known in Germany under the name of *light mill*—an appellation which seems to him scarcely justifiable, for the rotation of a wheel placed in the centre of a Geissler's tube seems exclusively produced by a dynamic effect peculiar to electricity, and in which light does not intervene in any manner. In fact, the vacuum is so imperfect that a radiometer placed in Geissler's tube cannot turn without the action of a ray of light. Further, the state of the surfaces has no influence upon the direction of rotation in Geissler's "mill," which is entirely bright, whilst the direction of this rotation is changed at will by altering the direction of the current. The preponderance of the negative flame, much more direct than the positive, cannot exert, as the author at first believed, any influence on this inversion, for a very sensitive radiometer, capable of being set in motion by the light from a smouldering match just blown out, was not moved by the light of an induction spark striking sufficiently near to the glass case to perforate it.

Crystallisation of Sugar.—M. G. Fleurens.—The value of this paper lies in tables which cannot be abridged.

Remarkable Case of the Reduction of Nitric Acid and the Oxidation of Acetic Acid with the Production of Alcohol under the Influence of certain Microzymas.—M. J. Béchamp.—The author controverts the view of M. Méhay that the decompositions in question are exclusively due to chemical reactions.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 873.

VOLUMETRIC ESTIMATION OF IRON.

By EDWARD HART.

By far the best method of estimating iron volumetrically is that by permanganate of potash, after previous reduction of the ferric to a ferrous compound. The difficulty encountered is how to perform this reduction in the best, quickest, and cheapest manner. The best and most complete method of reduction, according to my experience, is that by hydrogen, in a porcelain tube, at a red-heat. To make the reduction complete it is necessary to pass the gas over the heated ore for three hours. Not more than 0.3000 grm. of the ore should be taken, otherwise at the end of the time specified the reduction will be found to be incomplete. The ore is weighed out in platinum boats, four of which may be placed in the tube and reduced at once. The tube is allowed to cool while the hydrogen is still passing the boats, removed, and carefully dropped into flasks containing hot dilute sulphuric acid. The flasks are closed with doubly-perforated corks, and a current of hydrogen is passed into them while the iron is dissolving. When the solution is complete the flasks are plunged into cold water (hydrogen being still passed into them) and allowed to cool completely, and are then titrated in the usual way. Coal-gas cannot be used in place of the hydrogen, as some of its constituents dissolve in the hot acid and exercise a reducing action on the permanganate. With a great many ores, especially limonites, the reduced iron dissolves with great difficulty, sometimes not at all. This difficulty has been overcome by Dr. T. N. Drown, who passes oxygen or air over the heated ore for half an hour before reducing. The carbonaceous matter is in this way destroyed, and the reduced iron is found to dissolve with the greatest ease. In this modified form I know of no more elegant and accurate method of determining iron in its ores. Some results obtained at different times, on different ores, show the precision of the method. The numbers represent percentages of metallic iron.

No. 1.	No. 2.	No. 3.
62.19	66.69	47.97
62.25	66.64	47.86
62.11	66.64	48.01
62.22	66.55	48.09
Average, 62.195.	Average, 66.63.	Average, 47.98.
No. 4.	No. 5.	
48.88	52.00	
48.50	51.99	
48.67	52.04	
48.78		
Average, 48.71.	Average, 52.01.	

Almost all the magnetites when dissolved in acid leave a residue containing iron. The iron in this residue is not reduced by the hydrogen when the iron is determined as above. In this respect, however, the process is neither better nor worse than those ordinarily used. There are only two valid objections against this method. The first is the gas consumed, which makes it costly. The second the time required—from four to six hours. In order to find a means of determining iron very rapidly, with a reasonable degree of accuracy, various processes have been tried, but thus far none have given better results than that by reduction of the hydrochloric solution of the ore by stannous chloride. The ore was dissolved in hydrochloric acid in a beaker, and evaporated nearly to dryness. The solution was then diluted with a little

water, and an excess of stannous chloride run in from a burette. After the fluid had lost colour a little starch solution was added, and iodine solution run in from another burette until the blue iodide of starch remained permanent. It was found best to have the iron solution rather concentrated and warm. One c.c. of the stannous chloride solution was equivalent to about 0.0120 metallic iron and 3 c.c. of iodine solution. The stannous chloride worked best when freshly prepared. Ten determinations of iron in a limonite gave—

38.18	38.39	38.31
38.07	38.15	38.13
38.25	38.25	38.17
38.45		

Average, 38.235.

Two determinations of the iron in the same sample, by the preceding method of reduction by hydrogen, gave—

38.00 and 38.16.

A gravimetric determination by Dr. Drown, in another sample of the same ore, gave—

38.14.

These results for technical purposes are as good as is necessary. Four of the samples were weighed, dissolved, reduced, and titrated in an hour and twenty minutes. In a second trial, with four more samples, the same time was taken. In both cases the solutions were standardised while the ore was dissolving. This gives an average of twenty minutes as required for one determination, which is all that could be desired. I find it best to standardise the stannous chloride solution by means of metallic iron. This is dissolved in hydrochloric acid and a few pieces of potassium chlorate added; after which the solution is evaporated nearly to dryness. By this means every trace of free chlorine seems to be expelled. A solution of ferric chloride, when freshly prepared, is reduced almost immediately upon addition of the stannous chloride. After standing some time, however, it is more slowly reduced, and seems to require less tin solution. A solution of ferric chloride which had been kept for some months, one volume of which by precipitation in a platinum dish by ammonium hydrate gave 0.1024 and 0.1024 iron, when estimated by means of the tin solution gave—

0.1017	0.1010
0.1012	0.1007

results which are neither high enough nor closely agreeing.

Lafayette College, June, 1876.

NEW FORM OF COMPENSATING PENDULUM.

By J. LAWRENCE SMITH, Louisville, Ky

In the construction of this new form of compensating pendulum I have taken advantage of the very great expansibility of that combination of sulphur and caoutchouc known as vulcanite or ebonite. Its coefficient of expansion is known to approach that of mercury in the ranges of temperature from 0° to 70° C.

The mechanical arrangement adopted is a very simple one. The rod of the pendulum is of round steel, with an adjusting screw at the lower end; a round rod of vulcanite with a hole in the centre is passed on to the steel rod, fitting it loosely, and being held in place by the adjusting screw. The bob of the pendulum consists of a heavy mass of brass, with a hole through the centre large enough to admit the vulcanite over which it passes, and, by a properly arranged stop, rests on the end of the vulcanite farthest from the lower end of the pendulum, so that any expansion of the vulcanite elevates the brass bob, thus compensating for the downward expansion of the steel rod and brass bob.

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PLATINUM COMBUSTION TUBES.

IN Liebig's system of organic analysis glass combustion tubes are employed, to the exclusion of either metallic or porcelain retorts. But the chemists who first performed ultimate organic analysis occasionally used metallic combustion tubes, and Henry, in his work on chemistry, published in 1826, states:—"The tube for containing the mixture of the oxide and the body to be analysed is by some preferred of copper, by others of crown or green bottle-glass; but glass tubes seem, on the whole, to be preferable to metallic ones."

Although glass combustion tubes have been successfully used for a number of years, yet it is questionable whether glass is really the best material from which to construct apparatus intended to bear exposure to high temperatures.

A glass tube, as a rule, can only be used once, and when several analyses have to be performed "charging" the combustion tube becomes an extremely irksome duty. For filling the combustion tube is an operation which requires strict attention to minutiae, a slight deviation from some rule being sufficient to vitiate the results. And even when a tube has been carefully filled there is always a chance that it may either crack or "blow out" during ignition.

If an analysis could be performed in a few minutes an unsatisfactory result would be of trifling moment; but when the time spent over an analysis is remembered, a defective combustion means the loss of some hours' labour.

Platinum is apparently well suited for the construction of combustion tubes, and if tubes of that metal could be employed it is probable that the time spent over mechanical details in organic analysis would be considerably lessened. A platinum tube about 18 inches in length, and open at both ends, would be of convenient size for a combustion tube. Its internal diameter might be rather narrower than that of a glass tube, while its sides need not be thicker than that of an ordinary crucible. One end of the tube ought to be provided with a platinum cap, which should either slide or screw on, so that the junction between the two may be gas-tight at a red heat.

Given, then, a tube as above described; the question arises—How is it to be filled with cupric oxide? The following is a simple plan:—

- (1.) The inner surface of the tube is to be coated with copper. This is done by filling the tube with a solution of cupric sulphate, and then decomposing the salt by means of voltaic electricity.
- (2.) The tube having been well washed and dried, a cylinder of tightly-rolled fine copper gauze, about 9 inches long, and rather smaller than the internal diameter of the tube, is introduced, and pushed on until within 6 inches of that end of the tube which is provided with a cap.
- (3.) The tube with its contained cylinder of copper gauze is now heated to redness in a combustion furnace, and a stream of oxygen passed through it so as to oxidise the copper.

The substance to be analysed should be mixed with cupric oxide, and placed in a platinum "boat" about 5 inches in length; one end of the "boat" ought to be filled with dry potassic chlorate. The "cap" having been fitted on, and the potash and sulphuric acid bulbs attached, the whole of that portion of the tube which contains the 9 inches of cupric oxide can be heated to redness, and the analysis conducted in the usual manner.

By using small tubes, which could readily be weighed, it would be possible to determine the loss of oxygen experienced by the cupric oxide during a combustion. Suppose it is necessary to examine a body containing CHO. Arrangements would have to be made so as to allow a stream of nitrogen to pass through the apparatus.

The substance to be analysed is to be mixed with cupric oxide, and placed in the "boat." The bulbs, &c., are

then attached, and a stream of nitrogen passed through the apparatus so as to displace the air, and the analysis conducted in the usual way.

If the combined weight of the combustion tube and boat, with their contained oxide of copper, is known before ignition, then the loss after combustion will represent the amount of oxygen abstracted from the cupric oxide, and if the substance analysed contained no oxygen, then the amount of oxygen found in the potash and sulphuric acid bulbs will be equal in weight to the oxygen lost from the oxide of copper. But should the body contain oxygen then the difference between the amount of O lost by the cupric oxide and that found combined with the H and C will represent the amount of O present in the substance analysed.

With a platinum tube filled with cupric oxide in the manner above described it would be possible to perform a succession of analyses, thus greatly economising time. This arrangement of apparatus is based on purely theoretical considerations. I have had no opportunities of practically testing the value of platinum combustion tubes.

C. J. H. W.

Bhagulpore, Bengal.

PHOSPHINE (PH₃).

THE only method of obtaining absolutely pure phosphine is by the decomposition of phosphonium iodide by water, which yields PH₃ and HI, but very pure phosphine may be obtained by the action of sodic ethylate on P in alcoholic solution. The evolution of gas commences on warming slightly, and will continue regular for some days. From a strong alcohol solution the excess of hydrogen rarely amounts to more than 1½ per cent.

Aqueous and alcoholic solutions of ammonia (nitrite) produce, when digested with phosphorus, mere traces of phosphine, only either at the ordinary temperature or the boiling-point.

Clear phosphorus immersed in strong alcoholic ammonia and exposed to light (direct sunlight when that could be obtained) for a period of nearly six months, yielded only a very small amount of gas containing a trace of phosphine merely, a white crystalline deposit forming on the sides of the glass vessel in very small quantity. (It appears to be only white phosphorus.) Similar formation of crystals was noticed by Commaire.

A smaller amount of similar looking white crystals mixed with red phosphorus formed on the sides of a flask containing aqueous ammonia to which phosphorus had been added.

Glycerin does not prevent the formation of the spontaneously inflammable gas when added to the aqueous potash solution used for generating it; even strong glycerin with only 1 to 2 per cent water when treated with potash and phosphorus gives off the spontaneously igniting gas at the ordinary temperature slowly.

W. R. H.

Royal College of Chemistry.

CYANOGEN.

CYANOGEN, in solution in alcohol or water, rapidly undergoes decomposition, para-cyanogen, ozulmic acid, and ammoniacal products being formed.

With absolute alcohol saturated with dry gaseous cyanogen in the dark, a colouration due to decomposition was observed to commence after about an hour's exposure to sunlight (in February and March); the same solution maintained in darkness required four hours to develop the same depth of colour. The rate of decomposition is about the same when ether is used.

But when dry chloroform, carbon tetrachloride, crystallisable glycerin, carbonic sulphide, or benzol are used no colouration or decomposition was found to take place, even after exposure to sunlight for three months. In the case of the solutions which do undergo decomposition, such as alcohol, all the cyanogen is not removed or decomposed in the space of three months. A solution in absolute alcohol made in March (1876) still yielded a cyanogen distillate in June.

Royal College of Chemistry.

W. R. H.

PLASTIC SULPHUR.

It may perhaps be interesting to know that plastic sulphur may be formed at the ordinary temperature. When sulphuretted hydrogen is passed into water containing iodide in suspension, hydric iodide is formed and retained in solution, and a mass of sulphur is formed which may be drawn out into threads, and behaves in all respects like the plastic sulphur formed in the usual way by heat.

The whole of the sulphur is not in the plastic state, there being some ordinary precipitated sulphur intermixed. The colour is light red, due to iodine or probably a sulphur iodide.

Royal College of Chemistry.

W. R. H.

NOTICES OF BOOKS.

On the Presence of Arsenic in the Vapours of Bone Manure; a Contribution to Sanitary Science. By JAMES ADAMS, M.D.

It appears that early in the present year a gentleman in the north of Scotland, whilst passing into a railway station, "encountered a volume of offensively smelling vapour that was suddenly disengaged from a bone manure works, which (somewhat singularly, in our opinion) practically forms part of the station." He immediately, as we are told, became sick and faint, and "continued vomiting until he reached Inverness," where, in spite of the best medical advice there to be procured, he died on the fourth day after encountering the evil odour. His previous health is represented as having been excellent. On this fact, which, we should say, indicated some peculiar idiosyncrasy or very abnormal susceptibility on the part of the deceased gentleman, Dr. Adams founds a serious charge against chemical manure works in general.

The nuisances which they occasion are, according to our author, of a complex nature. There are, first, the gaseous exhalations from decomposing animal matter, which, we are told, "may not only cause a nuisance but they may kill." Of these gases carbonic acid and sulphide of ammonium are given as examples. We believe it is rather uncommon for these two compounds to be thrown off from a manure works in such an amount as to affect the health of the vicinity.

There are next miasms, morbid poisons, or organic poisons, the causes of fever, cholera, &c. These are by many authorities considered as solid organised bodies, merely held in suspension in the air. Dr. Adams, however, pronounces them "another class of gaseous exhalations proceeding from decomposing animal matter." However this may be he ventures to consider a manure works as dangerous, on this score, as a crowded church-yard. To this view we must take decided exception. The amount of putrescible matter received in ordinary manure works is very small. A large part of the bones worked up arrive as bone-ash and as spent bone-black; a

further portion consists of boiled bones, and even of the green bones a large quantity is generally dry and very unlikely to undergo decomposition. How stores of such materials can produce effects at all comparable to those of a crowded church-yard, where the bulk of the matter deposited is of a putrescent nature, Dr. Adams might find it difficult to show.

But there is yet a third class of emanations—volatile compounds of arsenic and antimony. The sulphuric acid employed contains arsenic, generally in the state of arsenious acid. This arsenious acid, in the process of dissolving bones, coprolites, apatite, &c., is decomposed by the chlorides, fluorides, &c., present, and there is, in consequence, an evolution of such delightful compounds as arseniuretted hydrogen, chloride and fluoride of arsenic, &c.

Now the presence of arsenic in pyrites, and consequently in sulphuric acid, is not to be disputed. Nor can the reaction by which it is said to be volatilised be pronounced impossible. But that it is given off to the extent here assumed may well be questioned. If arsenic is as widely diffused and as generally present as Dr. Adams holds the greater is the probability that it may have been present not in the suspected material but in some of the reagents employed. We should like to know whether, in all the investigations described or referred to in this pamphlet, a so-called "blank experiment" was first made to eliminate this source of error.

But there is yet a further question:—To what extent can chlorides and fluorides of arsenic and antimony be mixed with moist air, and to what distance can they be conveyed without undergoing decomposition? We should recommend Dr. Adams to take a station 600 yards from a manure works—the distance of Bunchrew House from the inculpatory factory—to draw a few thousand litres of air through water and to examine the resultant solution for arsenic.

Let us now examine the three sources of death and disease alleged to be given off from manure works, as here laid down. Miasms or organic poisons could scarcely meet with a more efficient corrective than chloride of arsenic, fluorine, and other of the volatile compounds said to be given off. On the other hand sulphuretted hydrogen and sulphide of ammonium are admirably calculated to purge the atmosphere of arsenical fumes.

We have had abundant occasion to examine chemical manure works, and have observed not merely the proprietors, officials, and workmen, but the population of the respective neighbourhoods. But there were neither mysterious and inexplicable deaths, nor a generally lowered tone of vitality. The only complaints we have ever heard had reference to the injury to vegetation from the fumes escaping from the chambers. We consider ourself fully justified in declaring that if manure works were the sole or the most formidable sanitary nuisance in existence we should have reached the condition of Dr. Richardson's model city. We should recommend manure makers to take every practical precaution (as indeed most of them already do), but we must protest against their being singled out for special condemnation on the score of a single case. If we load chemical manufacturers with conditions which render it impossible for them to work at a profit the result is not difficult to foresee.

Tables forming an Appendix to W. Dittmar's "Manual of Qualitative Chemical Analysis." Edinburgh: Edmonston and Douglas.

We have some time ago had an opportunity of expressing our opinion of Mr. Dittmar's valuable manual. The collection of tables, issued as an appendix, embrace "Metals, their mechanical and physical properties, and behaviour in the heat (an un-English expression); behaviour of metals with aqueous reagents; properties of the more important metallic oxides; metallic oxide and

dry-way reagents; generic reactions of mineral acid solutions of groups of metallic oxides; data for the discrimination of the oxides of the silver and copper groups; data for the discrimination of the oxides of the arsenic, iron, barium, and magnesia groups; general scheme for the analysis of a complex of metallic oxides dissolved in aqueous mineral acid or alkali; examination of filtrate from sulphuretted hydrogen precipitate; conspectus of methods for detection of non-metallic elements; action of salts on general acid detectors; and general scheme for the analysis of solids. The tables are printed on good paper and the characteristic reactions are brought prominently before the reader.

Annual Record of Science and Industry for 1875. Edited by SPENCER F. BAIRD. London: Trübner and Co.

This useful record has now reached its fifth annual volume, and in our opinion maintains its satisfactory character. In addition to a classified selection of extracts from scientific journals and the Transactions of learned societies, there is a general summary of scientific and industrial progress during the year 1875, an obituary of eminent scientific men, and a bibliography, which, however, does not profess to be exhaustive.

We believe that few discoveries, inventions, or other scientific facts of importance, will be found to have been omitted, and, as there is in every case a reference to the original authority, the work will be invaluable to all who wish to know the general results obtained during the past year. Much that is novel cannot be expected, since a considerable time must elapse after the expiration of the year before such an extensive assortment of facts can be compiled.

The classification of subjects is—Mathematics and astronomy, terrestrial physics and meteorology, general physics, chemistry and metallurgy, mineralogy and geology, geography, general natural history and zoology, botany, agriculture and rural economy, domestic and household economy, mechanics and engineering, technology, materia medica, and miscellaneous. This classification might doubtless be amended in several respects, but methodological accuracy is not in request in England, where the majority of the "respectable and intelligent classes" cannot even discriminate between "science" and "art," and apply the former term to very strange pursuits.

Causeries Scientifiques. Par HENRI DE PARVILLE. Paris J. Rothschild.

This work has now reached the fifth year of its useful career. The present issue, like its predecessors, gives a brief, chatty, and readable account of recent discoveries, inventions, and other topics of scientific interest.

The first paper, on the invasions of the sea, contains, among other things, a hypothetical map of the ancient isle of Atlantis,—not in accordance with the modern Dutch theory,—and a somewhat better established chart of the coast of France in the times when Jersey and Alderney were still part and parcel of the mainland. It is a somewhat unpleasant fact that the lands submerged within the last few thousand years seem generally to have had mild climates, whilst the territories recently elevated—such as certain parts of Siberia—are not merely cold and dreary in themselves, but are the lair whence the late Canon Kingsley's favourite wind issues to desolate Western Europe.

The next chapter contains an account of the "patent colours" of Croissant and Bretonnière, and of the tempered glass of M. de la Bastie, though the rival process of M. Siemens, of Dresden, seems to have been overlooked.

A notice of the recent discoveries on the carnivorous habits of certain plants is introduced, with the somewhat

strange remark that since the researches of Darwin "no one will accuse savants of being devoid of imagination!" Further on we are told—"Let the Darwinists continue their interesting romance." From some occult reason the countrymen of Lamarck look coldly upon modern Evolutionism, and have contributed very little to the recent progress of the organic sciences.

The account of the experiments of Prof. Heckel, of Montpellier, on the action of substances which hasten the germination of seeds, ends with a curious, and as some of our readers will think, an impertinent reflection:—"Who knows? pharmacy, which does so much evil to man, may, by way of compensation, do some good to vegetables."

There is an interesting notice of the effects of the rarefied air of high mountains upon the human life. The monks of St. Bernard rarely exceed the age of 35, and the majority of them die between 25 and 30. At the Little St. Bernard, according to Dr. Niepce, none of the inhabitants attain the age of 45. The author nevertheless thinks that moderate elevations, say from 800 to 1500 metres, are favourable to health and vigour. Here, although the amount of oxygen inhaled is smaller, yet, according to Jourdanet, the carbonic acid is eliminated more readily from the blood, and the vital energy may be consequently greater.

It is mentioned as a curious fact that ashes from the great fire of Chicago fell in the Azores on the fourth day from the commencement of the conflagration, whilst the empyreumatic odour led the inhabitants to suspect that some great forest was burning on the American continent.

According to the investigations of Dr. Viand Grand Marais the bite of the common viper is much more dangerous than is commonly supposed. Out of 362 cases which he has recorded, 63, or rather more than one-sixth, have proved fatal, one of the deaths occurring in two hours after the bite. It is remarked that in all these cases "ammonia had been largely employed," though we do not learn in what manner. The question is somewhat complicated by the fact that there are two species of venomous serpents in France, as indeed in all the more southern parts of Europe,—the true viper, "*pelide*" (*Pelias Berus*), found also in England, and the asp "*aspic*" (*Vipera aspic*), well known and dreaded in Illyria, Southern Hungary, &c. The latter is decidedly the more dangerous. At the same time, however, our attention has just been called to a reputed fatal case in England. A young man, named George Thompson, was bitten by a viper, whilst ascending Leith Hill, on July 27th, and died on the 29th notwithstanding medical treatment.

The section on vaccination and the small-pox may prove interesting during the present agitation anent the compulsory vaccination-laws. The author's views would scarcely, we fear, find grace in the eyes of the Local Government Board. He says—"No, vaccination does not place you in any case absolutely out of danger. Vaccinated, re-vaccinated, re-vaccinated again, you may still contract small-pox during an epidemic." These views, which are declared to be those of the highest medical authorities, certainly detract not a little from the glory popularly ascribed to Jenner.

On the sewage-question the author takes the opportunity of committing himself. He says—"Chemical processes of purification are costly and inefficacious. The sulphate of alumina, on which so much dependence has been placed, certainly clarifies sewage; the gelatinous alumina agglutinates the solid substances, but the dissolved matters, mineral and organic, are nowise retained (!) It clarifies; it does not purify." It is somewhat strange if chemists have still to learn that salts of alumina are perfectly able to precipitate not merely suspended, but dissolved organic bodies. Centuries of experience in dyeing and lake-making have put this beyond doubt. Nor must it be thought that colouring-matters are the only organic compounds capable of thus uniting with nascent alumina. It must further be remarked that in

the best precipitation processes the salts of alumina, iron, &c., are supplemented by bodies which have the power of absorbing and occluding the impurities, or of effecting their decomposition by the transfer of oxygen from the atmosphere.

The radiometer of Mr. Crookes is described and figured. Mention is made of the objection of Prof. O. Reynolds, and of the experiments by which it has been met. The author adds that M. Faye, a member of the Academy of Sciences, has long ago maintained that the rays of the sun were endowed with a repulsive force. Dr. Collongue, also, the inventor of the dynamoscope, published, about three years ago, a treatise on the attractions and repulsions of elder-pith under the action of solar heat and of that of the human body. "It is important to refer to these works from the point of view of historic truth, although they are not able to diminish the honour of Mr. Crookes's discovery."

The question of animal automatism, recently resuscitated, is also discussed here, and is very naturally extended from the rest of the animal kingdom to man.

We cannot further multiply extracts from this volume, but we have, we trust, furnished proof sufficient that it is replete with interesting and suggestive matter.

The Errors of Homœopathy. By Dr. BARR MEADOWS. London: G. Hill.

THE fundamental principles of Homœopathy do not appear to advantage in the "fierce light" of Dr. Meadows's criticism. Still we may doubt whether many of the class who, as patients, put their faith in Hahnemann and his system will be either willing or able to follow the train of reasoning presented in this pamphlet. Perhaps for the general public the most telling argument against the view that the power of a medicine is increased by dilution or "attenuation" is the rejoinder that if that be the case the same must hold good with contagions. Yet they are universally allowed to be rendered less powerful and active, just as ventilation is more perfect, in other words just in proportion as they are diluted.

A majority of the believers in Homœopathy, however, will decline to discuss principles and confine themselves to the success of some Homœopathic practitioner or hospital. This argument is very fully met. In Fleischmann's celebrated Homœopathic Hospital, at Vienna, the mortality is actually greater than—in fact, nearly double—the average mortality of half a dozen English provincial infirmaries and hospitals. Yet in the former the proportion of really serious, not to say incurable, cases is much the smaller. Somewhat amusing are the two counter-testimonials at the close of the work. An amateur Homœopathist declares "it is a national calamity and nothing else when a doctor is converted." On the other hand, a qualified Homœopathic physician denounces the credulity of his amateur colleagues and laughs at their supposed cures!

The Calendar of the Tokio Kaisai-Gakko, or Imperial University of Tokio, for the year 1875.

THE wonderful progress of the Japanese in Science and Industry has already attracted general attention, but many of our readers will doubtless be surprised to hear of the existence of a university so well organised and so amply fitted with every needful appliance. As a specimen of the arrangements we give some of the particulars of the department of applied chemistry, which is placed under the superintendence of Prof. R. W. Atkinson. Before entering this special department "the student must have completed the general course of study in the Kaisai-Gakko, or have passed a satisfactory examination in the English language, Inorganic Chemistry, Mathematics, and Elementary Physics." The course of study occupies three years and comprises the following subjects:—

Analytical chemistry, chemical technology, metallurgy, and organic chemistry. In the first year the course of chemical technology includes the following subjects:—wood, peat, coal; charcoal, coke, gas, artificial illumination, tar, and its derivatives; by-products of the manufacture of coal-gas; products of the dry distillation of wood; acetic acid, naphtha; mineral oils, nitre, nitric acid, gunpowder; the alkali manufacture; sulphur, its distillation and purification; sulphuric acid, salt-cake, soda-ash, caustic soda, hyposulphite of soda, recovery of soda from waste products; hydrochloric acid, chlorine, and bleaching-powder; salts of potash and soda; magnesium and aluminium, iodine, and bromine. In the second year the student enters upon tinctorial chemistry, the manufacture of glass and earthenware, soap, wines, sugar, explosives, &c. As far as possible opportunity is given to the students to see the actual working of the processes whose principles they have under consideration.

The professors in the University are Europeans or Americans, but there is a regular staff of native assistants, and no doubt the services of foreigners will be dispensed with as soon as there are natives sufficiently trained for the purpose. The Japanese are far too astute not to see that the nation which relies upon foreign talent and invention must ultimately see its own children sink down to be "hewers of wood and drawers of water."

A laboratory sufficient for all present wants has been built and fitted up. It comprises a large analytical room, a convenient lecture hall, store-rooms, office, &c. Apparatus, both chemical and physical, seem to have been liberally supplied. The works on chemistry and physics in the University Library amount to 2697 volumes.

The arrangements for the study of biology are scarcely so complete, but we learn with pleasure that the students are encouraged to form botanical and zoological collections. We are surprised to find such an utterly unsatisfactory work as Guizot's "History of Civilisation" selected as a text-book in the course of instruction on history and philosophy. Will it be surprising if some day Japan should become one of the seats of research, whilst England, suffocated by competitive examinations, reaches that state of immobility which we once thought characteristic of the far East?

CORRESPONDENCE.

WELDON'S PROCESS FOR THE MANUFACTURE OF CHLORINE.

To the Editor of the Chemical News.

SIR,—In the portion of your translation of Dr. E. Mylius's contribution to Dr. Hofmann's "Report on the Development of the Chemical Arts during the last Ten Years," which appears in the CHEMICAL NEWS, vol. xxxiv., p. 33, Dr. Mylius says, with respect to the process for the manufacture of chlorine which bears my name, "the following account is founded partly on Mr. Weldon's paper in the CHEMICAL NEWS (vol. xxii., p. 145), and partly on his letter to Dr. A. W. Hofmann, dated March 12th, 1874." In the portion of the same translation which is given in the CHEMICAL NEWS, vol. xxxiv., p. 55, Dr. Mylius attributes to me, as having been made in the letter referred to, the statement that M. Kuhlmann, among others, was "preparing," at the date of that letter, to adopt the process in question; and on this Dr. Hofmann says in a foot-note:—"On September 18, 1874, I found in the establishment of M. Kuhlmann no preparations for the introduction of Weldon's process."

As I am thus made to appear in the *Berichte* and in your columns, as having written to Dr. Hofmann something which is not true, I am sure I shall not count in vain on

your permitting me to show how utterly unjust is the position in which that foot-note places me.

Here, Sir, are the *ipsissima verba* of what I said about M. Kuhlmann in my reply, written on March 12, to the letter which Dr. Hofmann had addressed to me on February 22, 1874:—"The process has also been adopted in France by the Compagnie de St. Gobain, and is on the point of being adopted by M. Merle, M. Kuhlmann, and other French manufacturers." I thus simply did not use the expression attributed to me by Dr. Mylius, to which Dr. Hofmann attaches his foot-note. And as regards the expression I did use, I can conceive no form of words more exactly fitting the facts as they stood then. M. Kuhlmann had accepted a license for the use of my process as early as April, 1870. He had not at that time actually determined to adopt my process, but was waiting, like so many others, to see the results of Mr. Deacon's. The time came, however, when, on each occasion of my visiting Lille, he spoke of the adoption of my process as a thing now settled and decided upon, to be carried into effect so soon as the necessary attention could be spared for it. Early in 1874, before the date of my letter to Dr. Hofmann, I had been shown the site in the works at Loos, which had been determined upon for my apparatus; I had had prepared, at M. Kuhlmann's desire, the drawings and specifications from which, with some modifications, the plant now at work there has since been built; I had been consulted as to whether certain existing vessels and constructions could not be turned to account for it, and it had been decided that some of them could and should be, and that others of them could not; and I had received repeated and positive assurances that the construction of the plant would be commenced either towards the end of the year then current, or at the beginning of 1875. Under these circumstances, I thought then, and I think now, that to say that M. Kuhlmann was "on the point of adopting" the process was to put the matter as accurately as it could be put without entering into unnecessary detail.

And surely, Sir, looking back now on what has happened since, it is plain that the expression which I used in March, 1874, has been justified by the event, notwithstanding that M. Kuhlmann was a year longer in getting to work than M. Merle, who was equally spoken of in the sentence in which that expression occurs. I believe that M. Kuhlmann's apparatus was not actually ordered until January, 1875; but I have before me as I write evidence that M. Kuhlmann had opened negotiations with the Lancashire firm of engineers, of whom he eventually bought the mechanical part of it as early as July 17, 1874, so that this negotiation had been commenced two months before that visit to Loos on which Dr. Hofmann "found no preparations for the introduction of Weldon's process."

Earlier even than that, namely, in the month of May—four months before Dr. Hofmann's visit to Loos, and only two months after my letter of March 12—at a meeting at Paris of the French Association of Chemical Manufacturers M. Kuhlmann had said—"Although I am myself the inventor of a process for the regeneration of manganese, I am going to employ, not my own process, but Mr. Weldon's."

In the face of these facts I cannot understand Dr. Hofmann's foot-note. That he "found" "no preparations," &c., is quite intelligible in the sense that he saw no new constructions on behalf of the process either in progress or completed; but how he failed to become informed of how far those "preparations" had been carried which necessarily precede constructive work is very puzzling. I am not concerned, however, with the fact stated in the foot-note, but merely with the manner of stating it. It is so put as to do me very serious injustice. I am quite satisfied that the injustice is wholly accidental; and the far higher qualities which we all know to be united with the splendid intellectual gifts of Dr. Hofmann, and which have made him for so many of us not only a hero but almost an idol, make it certain that the accident has not befallen

through any lack of the most conscientious care. But the foot-note does me grave injustice all the same.

On another occasion I may ask your permission to point out certain errors into which Dr. Mylius has fallen in his account of the chlorine manufacture. Meantime I conclude by entreating of your courtesy that this letter may appear in your to-morrow's issue if possible.—I am, &c.,

WALTER WELDON.

Abbey Lodge, Merton, Surrey, August 17.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 2, July 10, 1876.

Influence of Physico-Chemical Forces on the Phenomena of Fermentation.—H. Ch. Bastian.—The author concludes from his experiments that the fermentation of urine is absolutely independent of germs which exist in the air.

Mineralogical Notices.—M. F. Pisani.—An account of the Amesite, of Chester (Massachusetts); Euchlorite, from the same locality: yellow Spessartine, of St. Marcel in Piemont; and Bastite from Elba.

No. 3, July 17, 1876.

Note on the Fermentation of Fruits, and on the Diffusion of the Germs of Alcoholic Ferments.—M. L. Pasteur.

Note on the Alteration of Urine, with reference to a Communication by Dr. Bastian.—M. L. Pasteur.

Intercellular Generation of the Alcoholic Ferment.—M. L. Fremy.—These three papers are rather biological than chemical, and relate to the vexed question of spontaneous generation.

Fourth Note on Electric Transmission through the Soil.—M. Th. du Moncel.—Not adapted for abstraction.

Measure of Electric Resistance in Liquids by means of the Capillary Electrometer.—M. G. Lippmann.

Transformation of Saccharose into Reductive Sugar during the Operations of Refining.—M. Aimé Girard.—Among the impurities which have an effect on the yield obtained from crude sugars in refining, practical men place in the first rank the reductive sugar found among the products of the cane. Till lately it was admitted that this glucose by its mere presence threw a double proportion of saccharose into an immovable state. Doubts have latterly been thrown upon this explanation; the facts are beyond dispute. The author finds that saccharose is alterable not merely in an acid medium, but even in such as are neutral or verge upon alkalinity. Peligot has already pointed out that under various conditions glucose becomes converted into acid compounds, and in that state doubtless acts upon the saccharose.

Detection and Determination of Magenta and Arsenic in Wines Artificially Coloured.—M. C. Husson.—The author places a few grms. of the suspected wine in a phial, and adds a little ammonia, when the mixture turns a dirty green. He then steepes in the liquid a thread of white woollen yarn, withdraws it when saturated, places it vertically, and allows a drop of vinegar to flow along it. If the colour of the wine is natural, as the drop advances the wool returns to its original whiteness, but if the wine has been sophisticated with magenta it is dyed of a rose, deeper or paler. He has also examined

the physiological action of magenta free from arsenic, and finds that, though not a violent poison, it produces some morbid phenomena. In a state of chemical purity he considers that its use would not occasion any great inconvenience.

Circumstances of Production of the Two Varieties of Sulphur, the Prismatic and the Octahedral.—M. D. Gernez.—An account of the precautions to be taken in order to obtain sulphur in the two states mentioned.

Critical Researches on Certain Methods Employed for the Determination of Vapour-Densities, and on the Conclusions to be Deduced.—L. Troost and P. Hautefeuille.—Not adapted for abstraction.

Action of Hydracids upon Selenious Acid.—M. A. Ditte.—The author states that the compound $\text{SeO}_2 \cdot 2\text{HBr}$ is capable of taking up more bromine, and forming the compound $2\text{SeO}_2 \cdot 5\text{HBr}$. He has also examined the behaviour of selenious acid with the hydriodic, hydrocyanic, hydro-fluoric, hydro-sulphuric, and hydro-selenic acid.

Observations on Iodine as a Reagent for Starch.—M. E. Puchot.—The author finds that the sensibility of iodine as a reagent for starch is affected by certain nitrogenous organic matters, such as albumen. If albumen is poured upon iodide of starch suspended in water the colour disappears. If albumen is added to a solution of starch saturated iodine water produces no colouration.

Rhodeine, a New Reaction of Aniline.—M. E. Jacquemin.—The author having mentioned that the hypochlorites of lime and soda cease to indicate the presence of aniline in solutions containing less than 1 centigram in 500 c.c. of water, shows that if after adding the test solution of hypochlorite to these dilute solutions there be further added a few drops of dilute sulphide of ammonium (1 part to 30 of water) a splendid rose colouration appears. In this manner 1 part of aniline may be detected in 250,000 of water. He gives the name rhodeine to the colouring matter thus generated. No other oxidising agent can be substituted for the hypochlorites, and no colour is obtained if a sulphite or hyposulphite is used instead of a sulphide. Diphenylamin and toluidin similarly treated produce no such reaction.

Action of Water upon the Glycols.—MM. Nevolé.—Not adapted for abstraction.

Existence in Spain of a Bed of Nickel Ores Analogous to those of New Caledonia.—M. Meissonier.—The ore in question is found in the province of Malaga, and is a silicate of nickel free from cobalt, and, it is intimated, from arsenic and antimony. The amount of nickel is about 9 per cent.

Microzymas of the Bladder as the Cause of the Ammoniacal Fermentation of Urine.—M. A. Béchamp.—A controversial paper, with reference to the papers of Pasteur, Joubert, and Berthelot (*Comptes Rendus*, lxxxi., page 5.)

Gazzetta Chimica Italiana.
Anno vi., 1876, Fasc. iv.

On Hesperidin.—E. Paterno and G. Briosi.—The hesperidin examined by the authors was extracted from the fruit of the common orange (*Citrus aurantium*), but it is found also in *Citrus limonum*, *Citrus medica*, &c. From 4000 ripe oranges they obtained 180 grms. of pure hesperidin. Its analysis gave the following results:—

C	..	..	..	..	..	53.80
H	..	..	..	..	..	5.88

Of nitrogen there was not a trace.

Experimental Researches on Electrostatic Induction.—G. Pisati.—Not suited for abstraction.

Elasticity of Metals at Different Temperatures.—G. Pisati.—Not adapted for abstraction.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 32, August, 1876.

Report of M. J. A. Barral on behalf of the Committee of Chemical Arts on the Pneumatic Malting Process of M. Galland, Introduced at the Brewery of Maxiville, near Nancy.—The principle of the invention consists in forcing air always at the same temperature and always saturated with moisture through the layer of barley with a speed exactly sufficient to remove the excess of carbonic acid. The barley may be spread to the depth of 30 to 50 c.m. The results are stated to be very satisfactory. From a statistical table given it appears that the average consumption of beer in Bavaria reaches the enormous amount of 219 litres per head, that of England being 118.

Report of M. Lamy on behalf of the Committee of Chemical Arts on the Manufacture of French Yeast and of Corn Spirit of Sprenger and Co., of Maisons Alfort (Seine).—Not adapted for abstraction.

Revue Universelle des Mines,
May and June, 1876.

This issue contains no chemical matter except a paper on the "Pyrites used in the Manufacture of Sulphuric Acid in France" taken from the *Comptes Rendus*, and already noticed.

M. Reimann's Farber Zeitung.
No. 25, 1876.

This issue contains a long leader on the condition of the dyeing trade in Berlin. According to the figures given a dyer loses on the average 53 plennige (about 4½d.) on every kilo. of woollen yarn that passes through his hands. It is now nothing uncommon to dye living animals. Some time ago a lady of the demimonde drove four greys dyed a splendid magenta in the Bois de Boulogne. White lap-dogs are often seen with light blue, green, and rose tails. (We have often seen ducks dyed magenta.) The manufacture of eosin has been commenced by A. Poirrier, of Paris.

No. 26, 1876.

This issue contains a notice that the method of producing pittakali, a blue colouring matter obtained more than thirty years ago from beech-wood tar by Reichenbach, has been re-discovered by Grätzel, of Hanover. It has the peculiarity of being coloured blue by alkalies and orange by acids. The shades produced with it are as fast as those yielded by indigo.

No. 27, 1876.

Manufacture of Orchil Extract and Paste.—According to the process of Saroz and Chognard (French patent) the lichens are macerated for a quarter of an hour in water, to which a little hydrate of lime has been added, and are then heated in a closed vessel to 100° to 120° by the introduction of steam at a tension of several atmospheres. The duration of the heating as well as the temperature are modified according to the kind of lichens made use of. The purpose of this heating is the rapid and complete conversion of the lichen acids into orcin. The clear liquid is then separated from the undissolved woody matter by a filter, a hydro-extractor, or a press, and concentrated by evaporation. It is then mixed with ammonia, and put in a tightly-fitting vessel of iron or wood, into which oxygen is conducted. The formation of orcein is thus more rapid than on the common procedure, in which the extract is left to the action of the atmosphere. The oxygen prepared by the process of Tessié du Motay enters at the bottom of the vessel by means of a perforated tube: the portion not absorbed is conducted away by a second pipe passing through the lid, and may be reserved

for a second operation. The evaporating ammonia escapes through the same pipe, and is absorbed in water with a view to its being re-utilised. When the oxidation is complete, and the liquid contains an excess of ammonia, it is driven off by exposure to the air or by a gentle heat. To prepare orchil paste, the above-described extract, after concentration and mixture with ammonia, is thickened with a quantity of extracted lichens, and treated with oxygen. The closed vessel is provided with a mechanical agitator. When the oxidation is complete the paste is allowed to stand for some days exposed to the air, with occasional agitation.

No. 28, 1876.

This issue contains a paper on the depressed state of the tinctorial trades, and an announcement that Dr. Ferd. Springmühl is undergoing a prosecution for having insulted Prince Bismark and the Emperor ("*Ego et rex meus*").

An establishment has been opened in Belgium for extracting the wool from grease by means of alcohol and ether. The yield, according to preliminary experiments, is understood to be large. Similar attempts with other liquids, *e.g.*, bisulphide of carbon and fusel oil (Richter's process), have failed owing to the escape of the solvents.

No. 29, 1876.

This issue, again, contains complaints on the depressed state of the dyeing trade in Berlin and the unremunerative scale of prices.

Consumers of vanadium salts are cautioned against tasting any mixtures in which such are present, or bringing them in contact with any part which has been deprived of the cuticle, as they are intensely poisonous. Prussiate of potash and tannin are proposed as antidotes.

MISCELLANEOUS.

University of London.—Several important changes have been made in the regulations for the degrees of Bachelor and Doctor in Science, conferred by the University of London. In the Matriculation examination German may now be substituted for Greek. In place of the superficial acquaintance with both Zoology and Botany, formerly required at the first B.Sc. examination, there will be a single examination (written and practical) in General Biology, in which a more thorough knowledge will be required of the simplest forms and elementary phenomena of Animal and Vegetable Life, such as is now made the basis of the teaching of some of the most distinguished professors in each department. Thus the student who may be intending to devote himself specially to Physical or Chemical Science, will be brought to apprehend the general conceptions common to the two great Organic Kingdoms, without being required to master the specialities of either. And the student who intends to present himself at the second B.Sc. examination in either Physiology, Zoology, or Botany, or all combined, will have laid the best foundation for those special studies in the study of General Biology. The regulations for the second B.Sc. examination are framed with the view of allowing the candidate to bring up *any three* of the following nine subjects:—

1. Pure Mathematics.
2. Mixed Mathematics.
3. Experimental Physics.
4. Chemistry.
5. Botany, including Vegetable Physiology.
6. Zoology.
7. Animal Physiology.
8. Physical Geography and Geology.
9. Logic and Psychology.

It is intended that the examinations in these several subjects should be, as nearly as may be, on the same grade, as to the amount of attainment they require. The experience of the Examiners in Mathematics justifies them in stating that any candidate who has thoroughly mastered the Mathematics of the first B.Sc. examination, and who has such an aptitude for the study as would lead him to select Pure Mathematics as one of his subjects at the second, would find no difficulty in mastering the requirements of its programme, by such an amount of study, carried on through an eight months' Academical Session, as would leave him free to bestow the same amount of time and attention on *two* or even *three other* subjects. It is understood the amount of proficiency expected in each of the three subjects chosen will be that which the candidate might attain by the steady devotion to it of about one-third of the sessional work of a diligent student. In regard to the Doctor's degree a change has been made in favour of candidates who prolong the interval between their first and second examinations for the degree of Bachelor from one year to two or more; as such will be allowed to come up for the degree of Doctor of Science within a year of their attaining the degree of Bachelor. We shall refer at greater length to the new regulations in our Student's Number, which will be published on September 15.

Analysis of the Weissenburg Water.—The springs of Weissenburg, in the Bernese Oberland, enjoy a considerable reputation as useful in the treatment of pulmonary affections. Cavities in the lungs are said to become cicatrised by its use. Its chemical composition can scarcely be said to throw much light upon its medicinal efficacy. The two main ingredients, according to Dr. Stierlin's minute and evidently careful examination, are sulphates of lime and magnesia. Lithium is present as chloride and iodide, the latter only in very minute quantity. There is an organic compound having the odour of blackberries, and also caesium and rubidium in traces too small for quantitative determination.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the production of white lead and in the apparatus employed therein. L. Brumleu, Newcastle-on-Tyne. April 20, 1875. No. 1437. The essential features of this invention consist in first effecting the division of the lead to be converted into white lead, and then subjecting the same contained in a suitably arranged chamber to the action of either acetic acid or of acetate of lead, or of mixtures of the same, and also to the action of air and of carbonic acid; the chamber or chambers being so constructed that a rocking motion may be given to them in order that the white lead formed upon the surface of the lead may be removed by the action of the solution contained therein, and a fresh surface be thereby exposed.

Improvements in the treatment and preparation of certain chemical compounds for the purpose of rendering their carriage, sale, use, and application more convenient and economical. T. Hyatt, Gloucester Gardens, Hyde Park, London, Middlesex. April 21, 1875.—No. 1451. My invention relates to the consolidation of chemical substances, such as sal-soda, alum, and other compounds containing water of crystallisation, for the purpose of lessening their bulk, and thus diminishing the cost of packing, handling, and carriage, and also for the purpose of preventing the waste which arises when such substances are in powder or in crystal form; also to make their employment in domestic use, and in the arts and manufactures, more precise, convenient, and economical. My invention also relates to the consolidation of materials other than the above, when such materials are joined, mixed, combined, connected, or united to them in the production of new and useful manufactures, such as soda and seidlitz powders in medicines, and such as fireproof compositions, or compounds in the manufacture of fireproof safes, and in the protection of buildings or other constructions against fire.

Improvements in the manufacture of manure from certain mineral phosphates. P. Spence, Newton Heath, Manchester, Lancaster. April 21, 1875.—No. 1455. This invention relates to a method of treating phosphates of alumina, or phosphates of alumina and iron, whereby valuable manure is obtained. The substance chiefly used is that called Rodonda phosphate, and the treatment thereof is an improvement upon that method for which a Patent was granted to the present inventor, dated June 9, 1870, No. 1676.

Improvements in the manufacture of artificial fuels. C. Kingsford, Fulham, Middlesex. April 21, 1875.—No. 1458. This invention mainly consists in consolidating small coal or slack, or similar substances, by addition thereto of a composition made of a solution of silicate of soda or potash, to which a small quantity of pitch or other suitable substance is added, and to enable the pitch to combine with the solution the silicate is heated with a small quantity of flour or suitable paste-making materials to convert it into a paste, and while hot the pitch is added. For consolidating the substances the composition while hot is submitted to pressure. The coal may be ground, and, if desired, mixed with clay and lime, which react upon the silicates, and hasten the solidification of the fuel.

Improvements in the manufacture of manure, and in the apparatus employed therein. J. H. Johnson, Lincoln's Inn Fields, Middlesex. (A communication from H. O. P. Lissargay, Pantin, France.) April 22, 1875.—No. 1484. This invention relates to the manufacture of soluble and putrescible manure from new products obtained by the special treatment of nitrogenous substances, such, for example, as leather, wool, and horn, which in their natural condition are insoluble and impurities, and also to apparatus to be employed in operating upon the before-mentioned substances.

Improvements in the manufacture of glucose or grape-sugar from rice or other grain. E. E. Pearse, Oberstein Road, New Wandsworth, Surrey. April 23, 1875.—No. 1489. This invention has reference to Letters Patent, No. 1044, 1873, and relates to the use of a small jet of water or other suitable liquid to flow in with the grain as it passes into the saccharifier through the feed-trough to prevent any tendency to choking. By these means the operation on broken and refuse grain, as well as the operation on grain that has previously been reduced to small particles or powder, is facilitated.

Improvements in the manufacture of perforated blocks of chloride of sodium or chloride of potassium for use in the manufacture of sulphate of soda and sulphate of potash. J. Brock, Widnes, Lancashire. April 23, 1875.—No. 1502. This invention consists in making perforated blocks of the salts named by placing the crystals wet from the boiling pans in frames filled with taper pegs, and then draining, turning them out of the frame, and stoving them.

Improvements in the method of and apparatus for purifying carburetted hydrogen gas. H. W. Cook, Thurlow Square, Middlesex. April 23, 1875.—No. 1505. The objects of this invention are to economise the chemical ingredients employed for the purification of gas. To this end the purifying materials (say lime, for instance) are presented to the gas in such a manner that they will act energetically on the gaseous impurities, and will offer continually fresh absorbing surfaces.

Improvements in the manufacture of sugar from sugar-canes, and in apparatus to be employed therein, which apparatus is also applicable to other like purposes. B. Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from A. F. C. Keynoso, Paris.) April 28, 1875.—No. 1558. This improved process is essentially different from all those which are now employed, and consists in the complete extraction of the juice from the sugar-cane or sorghum. For this purpose, instead of rolling the canes or sorghum in a mill, the inventor commences by cutting them in pieces by means of cutters or knives suitably arranged; these pieces are then reduced into a pulp by means of rasps, millstones, revolving cylinders, or plates, or other mechanism or apparatus adapted to lacerate the cellulose in order to obtain by the complete crushing thereof a homogeneous paste. The pulp thus obtained is submitted to the action of the ordinary presses, or hydraulic or other presses, or any other process employed to separate the juice therefrom. This apparatus may also be employed for the extraction of starch from tapioca and other roots, and for the reduction to pulp of cocoa-nuts and other fruits, or for the treatment of sorghum or maize, either for the extraction of sugar or the preparation of food for animals.

Improvements in apparatus or appliances employed in the manufacture of sulphates of soda and potassa. J. Hargreaves and T. Robinson, both of Widnes, Lancaster. April 29, 1875.—No. 1576. This invention relates to our direct-action process for the production of sulphates of soda and potassa, and consists—(1) In the employment of an overhead steam or other crane for charging the chambers. (2) In using the said crane in combination with a weighted or other tool for loosening the sulphate in the chambers. (3) In employing a revolving shaft provided with expanding cutters to loosen the sulphate. (4) In employing troughs or endless travelling bands to carry away to the desired place the finished sulphate. (5) In lengthening the filling necks, and filling the intervening spaces with non-conducting material to form a working floor and prevent radiation. (6) In forming the hydrochloric gas flues of iron to prevent leakage.

Improvements in dyeing or printing. C. A. Martius, Berlin, Prussia. April 29, 1875.—No. 1584. This invention relates to improvements in dyeing or printing with aniline and other coal-tar colours without the use of mordants now necessary when those colours are employed, by the employment of the fatty salts of the bases of the aniline colours, or the other basic coal-tar colours dissolved in alcohols or in the hydrocarbons of the benzol and petroleum series, the above-mentioned salts being insoluble in water.

Improvements in treating slag from blast-furnaces to produce a new article of manufacture. E. T. Hughes, Chancery Lane, London. (A communication from M. E. Bergius, Mannheim, Baden.) April 30, 1875.—No. 1595. This consists in treating slag with a blast of steam so as to transform it into a cotton-like state, which is called silicate cotton.

An improved process for the manufacture of red sulphide of mercury. A. M. Clark, Chancery Lane, Middlesex. (A communication from W. J. S. Grawitz, Paris.) April 30, 1875.—No. 1604. The invention consists in manufacturing red sulphide of mercury by dissolving without the aid of heat, and whilst protected from the action of light, either the binoxides of mercury or the salts of the binoxide of mercury

in a soluble hyposulphite, the precipitate obtained being gradually raised in temperature in order to deposit the sulphide of mercury.

Improvements in the production of aniline-black for printing and other purposes, and in dyeing aniline-black. A. M. Clark, Chancery Lane, Middlesex. (A communication from W. J. S. Grawitz, Paris.) May 1, 1875.—No. 1620. This invention relates to the production of aniline-black, first, in the form of a paste or powder for printing purposes, and for the manufacture of colours, varnishes, and inks of all kinds; and, secondly, the fibres of textile fabrics, by the concurrent reaction on aniline oil of certain metallic salts, and certain chromates or bichromates.

An improved method of and apparatus for filtering and deodorising sewage so as to prevent rivers being polluted thereby. T. Pape, Great Alfred Street, Nottingham. May 3, 1875.—No. 1625. The chief features of the invention consist in a machine being placed horizontally on a shaft driven by steam-power, and when once set in motion the apparatus is self-acting, and never need stop except for repairs.

Improvements in the manufacture of chlorine. H. Deacon, Appleton House, Widnes, Lancaster. May 3, 1875.—No. 1632. The essential feature of this invention consists in the employment in what is known as Deacon's chlorine process of the residue of burnt or calcined pyrites or sulphurets of iron, such residues being either impregnated with a salt of copper, or the copper contained therein, being rendered soluble and active either by means of water or by means of an acidulated solution.

Improvements in the manufacture of sulphuric anhydride. E. Sonstadt, Highgate Road, Middlesex. May 3, 1875.—No. 1638. This invention consists, first, in substituting anhydrous sulphate of magnesium for the ordinary ferric sulphate or other like substance usually employed in manufacturing or obtaining sulphuric anhydride. At about the melting-point of cast-iron, the anhydride is completely driven off, and may be condensed in the usual manner. This invention consists, secondly, in using ordinary magnesium sulphate for the same purpose. The water of crystallisation is first completely driven off at a temperature below a red heat, then the heat is raised, and the process is continued as in the first part of the invention.

Improvements in the method of treating grease for the purification thereof, to be used in the manufacture of soap and for other purposes. J. Hopkinson, Southfield Square, Bradford, York. May 5, 1875.—No. 1667. Of the grease to be purified I make a lime or insoluble soap, and dissolve out the impure fat with a suitable solvent: I prefer bisulphide of carbon applied under pressure or otherwise. The same is run into a still, and the bisulphide of carbon is distilled off, leaving the impure fat in the still. The fatty acids distilled are decomposed by means of an acid; I prefer hydrochloric, which liberates the fatty acids from the lime base.

Improvements in the manufacture of artificial fuel. J. Deere, Brighton, Sussex. May 5, 1875.—No. 1680. The fuel is composed of coal, lime, clay, gypsum, or copperas, mixed with a gelatinous solution.

Improvements in the purification of gas. J. Whitley, Roundhay, York. May 6, 1875.—No. 1694. This invention describes a means of purifying gas by filtering it through layers of cotton-wool or other fibrous material.

Improvements in apparatus for utilising inflammable fluids for illuminating and heating purposes. H. Browne, Raymond's Buildings, Gray's Inn, Middlesex. May 7, 1875.—No. 1701. This invention has for its objects the improvement of the means of employing inflammable fluids, such as petroleum, naphtha, and the like, for illuminating and heating purposes, and also the rendering the employment for such purposes of such inflammable fluids less dangerous, and consists of an arrangement of reservoirs, pipes, and cocks for supplying the fluid to the lamps or other apparatus automatically.

Improvements in the treatment of substances containing alumina and iron for the purpose of obtaining certain useful substances therefrom. P. and F. M. Spence, Newton Heath, Manchester. May 7, 1875.—No. 1704. This invention relates to the production of a cake of sulphate of alumina and iron from minerals known under the name of bauxite.

A new or improved process for oxidising anthracene, and improvements in the colouring matter produced therefrom. C. Heinzerling and G. McGowan, Glasgow, Lanark, N.B. May 8, 1875.—No. 1712. The features of novelty which constitute this invention are the treatment of anthracene with bleaching-powder, and dilute or non-dilute hydrochloric or equivalent acid, and treating alizarin with cyanide or sulphocyanide of potassium.

Improvements in the manufacture of soda. J. Mactear, Glasgow, Lanark, N.B. May 8, 1875.—No. 1714. This invention relates to an improved combination of processes, whereby in the manufacture of soda a part of the operations hitherto required may be dispensed with, whilst soda sulphate is more completely separated from the products and profitably utilised.

Improvements in the manufacture of sugar. A. Manbré, Cleveland Villas, Penge, Surrey. May 8, 1875.—No. 1724. My invention has for its object improvements in the manufacture of glucose-sugar for brewing purposes. I have found that by mixing a portion of cane-sugar with a portion of glucose-sugar, and by subjecting the mixture to the action of heat and in a vacuum, I am able to produce a new kind of sugar, which I call a "specialite sugar," for making beer, possessing all the properties required for producing bitter, India, and other pale ales, common beer, stout, and porter of the finest and purest quality, possessing great fullness and great delicacy of flavour.

Improvements in the production of compounds containing xyloidine, and in the application of the same. D. Spill, High Street, Homerton, Middlesex. May 11, 1875.—No. 1739. This invention relates to improvements in the production and application of xyloidine, and of those compounds which consist essentially of what is known as soluble gun-cotton, specially applicable to the manufacture of fuses, fusee tubes and imitation tortoise-shell or turtle-shell.

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METACHROMATISM, OR COLOUR CHANGE.

By W. ACKROYD, Mem. Phys. Soc.

MANY inorganic bodies change colour, when they are heated, without suffering any alteration of chemical composition. These changes embrace a class of phenomena quite as important in their way as those of phosphorescence and fluorescence, with which, in fact, they are intimately connected. We venture, therefore, to propose for the phenomenon the name of *Metachromatism*, from the Greek *meta*, change, and *χρῶμα*, colour, and it will be convenient to call colour-changing bodies *metachromes*.

Metachromatism has received a fair share of attention from scientific men in time past. Their labours, however, are not even referred to in our text-books of chemistry and physics,—perhaps from the importance of the subject being under-rated, and its bearings not being clearly seen. Hence when, at an early stage in its study, we saw that *nearly all metachromatic changes take place in a definite order, the order of the spectrum colours*, we were under the impression, even after much reading, that the subject was quite unworked.

Stahl and followers made note of the chameleon-like behaviour of certain metallic oxides, and Schönbein,* who studied the subject, inferred from his observations that heat imparts a darker colour to metachromes, and generally red or brown. Sir David Brewster† called attention to the change in the absorption-bands of nitric peroxide when that body is subjected to heat, and twenty years later (1857) Gladstone made observations‡ on the change of colour in salt solutions upon elevation of temperature. He observes that whilst some really exhibit colour change,

in others there is simply an alteration of the intensity of the transmitted light. Houston and Thompson,|| in a paper wherein no reference is made to prior workers, clearly enunciate the order of change given above.

Hartley§ has made observations on the action of heat on the absorption spectra and chemical constitution of saline solutions. In the substances he has studied he regards colour-change as evidence of alteration of hydration.

I. Metachromes, their Department and Classification.

A large series of spectroscopic observations were made of metachromatic solutions, at low and high temperatures, for purposes of comparison. The change in most cases is very small, and may readily be confused with sources of observational error. Our main object being to arrive approximately at the cause of the phenomenon, solutions were discarded, and stable anhydrous bodies experimented with in their stead. The advantages accruing from this course are many, and such a course is moreover necessary for (1) the elimination of chemical action, and (2) a more decided change in colour, from the greater range of temperature it is possible to employ. The table below contains a list of a few anhydrous metachromes, with their changes, in addition to many of those given by Schönbein, Gladstone, and Houston and Thompson.

The changes were observed on white porcelain in preference to sheet copper, as used by Messrs. Houston and Thompson. This metal at the temperatures employed is soon covered with a film of suboxide, and the play of colours on its surface, unavoidably produced by variation of temperature, can scarcely fail to give a wrong impression of the change in the metachrome under observation.

The behaviour of mercuric oxide calls for a few remarks, since here decomposition was observed at a comparatively low temperature. Resolution commenced at 230° to 232° C., 760 m.m. bar., metallic mercury being deposited in the cooler parts of the containing tube as a scarcely perceptible film, in which globules could only be made out with the aid of a lens.

Table I.—METACHROMATIC CHANGES.

Metachrome.	Normal Colour.	Change.
Mercuric oxide	Orange-yellow.	(In N, air, and CO ₂ .) Orange, red, and brown.
Zincic oxide	White	(In N, air, and CO ₂ .) Yellow and orange.
Cinnabar	Scarlet	(In sealed tube.) Dark scarlet and puce (240° C.).
Mercuric iodide	16° C., Red	Dark red.
"	140° C., Yellow	(In sealed tube.) Orange and red.
		(The same change under paraffin.)
Manganous oxide	Greenish grey	(In hydrogen.) Greenish yellow.
Plumbic oxide	Yellow	(In air and CO ₂ .) Orange and red.
Chromic oxide	Green	Yellow, and when cooling just after the 'glow' of a bluish cast.
		Perceptibly greener.
Manganates of potash and soda	Bluish green	Nearly black.
Red oxide of manganese	Reddish brown	Orange-yellow, changes suddenly to orange-red.
Thallious iodide	Yellow	Orange and orange-red.
Seasquichloride of thallium	Yellow	Yellow and orange-yellow.
Thallious bromide	Yellowish white	Red and dark red.
Terchromate of thallium	Orange-red	Orange, red, and deep red.
Neutral chromate of thallium	Orange-yellow	Green and greenish yellow.
Metaborate of copper	Blue	Yellow.
Porcelain	White	Blackish red and black.
Suboxide of copper glass	Scarlet	Orange.
Chromate of barium	Yellow	Brick-red and black-red.
" of lead	Orange	Orange and red.
Plumbic iodide	Orange-yellow	Greener cast; and from 105°—116° C. to fusing-point, orange, red, and dark red.
Argentific iodide	Yellowish white	Orange and reddish brown.
" phosphate	Yellow	Dark red.
Potassic dichromate	Red	

* Point of maximum density (Rodwell).

* Gmelin's "Chemistry," vol. i., p. 238.

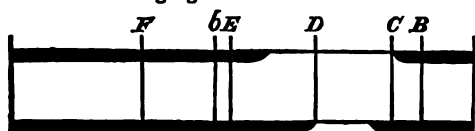
† Proceedings of the Royal Society, vol. cxvii., p. 247.

‡ Phil. Mag., vol. xiv., p. 423.

|| Journal of the Franklin Institute, October, 1871, and CHEMICAL NEWS, vol. xiv., pp. 177 and 188.

§ Proceedings of the Royal Society, No. 161, 1875.

To ascertain the more intimate nature of the change in these anhydrous bodies was a work of some difficulty until the following simple expedient was devised:—Crystalline metachromes were used. The finely-powdered body was placed upon the concave side of a watch-glass, and pressed into a thin layer by the convex side of a second glass. The spectrum of the transmitted light being obtained at the normal temperature, the temperature was now raised, and a second spectrum obtained for comparison. Such a comparison for potassic dichromate we have in the following figure:—



It will be observed that upon elevation of temperature the absorption-bands at the ends of the spectrum widen out, and the more refrangible increment of absorption is nearly double that of the less refrangible. From the last observation the spectral order of change characteristic of metachromatism follows as a natural consequence, the less refrangible constituents of a body's reflected light being, so to speak, more persistent than the more refrangible during elevation of temperature.

In a certain class of bodies, like ZnO, the spectrum order of change is not so evident, from the fact that white has strictly no place in the spectrum. To this class belongs such bodies as TiO_2 , Ta_2O_5 , MoO_3 , Sb_2O_3 , Sb_2O_4 , SnO_2 , white porcelain, lead glass, colourless solution of ferric nitrate, and nitric peroxide at low temperatures, which, being white or colourless, become yellow upon elevation of temperature. In another and larger class, of which borate of copper and plumbic oxide may be taken as examples, the spectrum order is very evident. Both classes alike owe their change to increased absorption of light, with elevation of temperature; and a white body, if the temperature be raised high enough, may be made to pass not only from white to yellow, but also from yellow to orange, and thus the line of demarcation between the two classes is broken down. Reflecting upon these facts, we see that it is possible to arrange the colours in order: this we have done as follows:—



The position of all the members, save the lowest three, is determined by experiment. That white has the position we give it seems probable because—(1) by experiment with the ZnO class of metachromes it plainly occupies a position at the opposite end of the scale to orange and red; (2) the behaviour of blue and green metachromes precludes its being placed between these two colours; and (3) it is the direct opposite of black. Violet and indigo are only placed in the scale provisionally to make up the spectrum colours, as there are no experiments to warrant their being so placed.

The metachromatic scale may be looked upon as showing the colour effects of expansion on the one hand, or of contraction on the other. And were it possible to reach the absolute zero of temperature we should probably have there colours of the white end of the scale.

II. Theories of Metachromatism.

Stahl and followers connected colour-change with the varying amounts of phlogiston a body was supposed to contain when being heated. Schönbein supposed the metachromes underwent what he termed an incipient decomposition,—i.e., one of the elements was supposed to be held in a peculiar state of combination whilst hot, and to regain its normal position upon cooling. Mercuric oxide, for example, was thought to assume the brown-black colour of the suboxide from losing a part of its oxygen, which was retained in a peculiar manner in the mass. Now mercuric oxide, from being an exception to a law which we shall presently state, appears to favour Schönbein's hypothesis. When we think, however, over the fact that this oxide is partially decomposed at $232^\circ \text{C}.$, whilst it is in the deep orange state, we see that no suboxide is really formed.

It is difficult to see how the hypothesis can apply in the case of borates, phosphates, and silicates. That it does not hold with binary compounds will be evident after a consideration of the following law, which we discovered during our study of this subject:—*In a series of anhydrous binary compounds of the same two elements, those which have the highest amount of the basylous element have the most refrangible colours, and, vice versa, those which have the least amount of the basylous element have the least refrangible colours.* The table below illustrates this, and it will be found to hold good in many more anhydrous series than are given here.

From the table it is evident that decomposition (incipient or complete) of any particular compound would give us more refrangible colours instead of the less refrangible, which is the result of elevation of temperature,—e.g., incipient decomposition of the brown PtCl_4 would give us the more refrangible green PtCl_2 .

It is not our intention here to enter minutely into Messrs. Houston and Thompson's theory: the reader is therefore referred to their paper in the *CHEMICAL NEWS* (vol. xxiv., pp. 177 and 188). We note that (1) no men-

Table II.—SHOWING COLOUR RELATIONS OF ANHYDROUS BINARY COMPOUNDS.

Metachromatic Scale.		Each Series arranged Vertically.									
Black ..	Au_2S_3		In_2O_3	CuO	MnO_2	Ni_2O_3		Co_3O_4		Pb_2O (?)	
Brown ..	Au_2S		CuS_2		Mn_3O_4 & Mn_2O_3	Au_2O_3	CdO			PbO_2	
Red ==	PtCl_4	Bi_2O_5		Cu_2O			AuCl_3	HgI_2	CrO_3	Pb_3O_4	Fe_2O_3
Orange											
Yellow		Bi_2O_3	In_2O_3				AuCl	Hg_2I_2		PbO	FeO
Green ..	PtCl_2		In_4O_5	MnO	NiO	Au_2O	Cd_2O	Hg_2I_2	CoO	Cr_2O_3	Sb_2O_5
Blue ..											
Indigo ..		CuS (Ind. copper)									
Violet ..		Cr_2Cl_6									
White or } Grey } (Metal)		CrCl_2	In_7O_9								Sb_2O_3

tion is made of the part absorption takes in this phenomenon, probably arising from their not having studied the subject spectroscopically; and (2) that they speak of metachromes as if generating light after the manner of incandescent bodies. That absorption plays an all-important part will be evident from what we have said in Section I., and that vibratory motion has little, if anything, to do with metachromatism we hope to make clear in the sequel.

Our experiments demonstrate that metachromatism does not depend upon the surrounding medium, for bodies exhibit the change alike in nitrogen, air, carbonic anhydride, and hydrogen. It has been suggested that the phenomenon might in some way be due to volatilisation. A volatile body, however, exhibits the change under a liquid medium. Hence we conclude that it is due in some manner to the action of heat on the internal structure of the metachrome. Metachromatism is seen in solids,—amorphous and crystalline,—in liquids, and in gases near their liquefying points (N_2O_4 and Br_2^*). These forms of matter have molecular structure in common; hence we attribute metachromatism to molecular alteration. What the nature of this alteration may be we think will be manifest after a close consideration of certain physical facts.

Absorbed heat performs two kinds of work:—

- i. Kinetic, sensible to the thermometer, and—
- ii. Potential.

a. The overcoming of cohesion, molecular recession, or molar expansion, as, *e.g.*, the conversion of ice into water, and water into steam. *This kind of work is accompanied by a change of density.*

β . The overcoming of chemical attraction, atomic recession, or molecular expansion, which finally ends in decomposition, as, *e.g.*, the resolution of PtCl_4 in PtCl_2 and Cl_2 .

I. It is a fact well known to mineralogists that many anhydrous silicates, after being subjected to a high temperature, have upon cooling permanently changed colours. This is shown in the following table† in each example save that of olivine.

	Density before Ignition.	After Ignition.
1. Olivine ..	Pistachio-green, 3.389	Pist.-green, 3.378
2. Beryl ..	Straw-yellow, 2.697	Blue, 2.697
3. Topaz ..	Sherry „ 3.539	Pink, 3.533
4. Zircon ..	Brown, 4.515	White, 4.540
5. „ ..	Aurora-red 4.863	Colourless, 4.863

It will be noted that where colour and density are both permanently altered, as in 3 and 4, the warm-coloured variety is less dense than the same mineral with a cold colour,—*i.e.*, the densities are in the order of the metachromatic scale, a fact we anticipated in our study of this matter. This is also strikingly evident among allotropes, the notable exception being here, as elsewhere, that of phosphorus. Red amorphous phosphorus is denser than the yellow: this very fact, however, will no doubt tend to throw light on some of its other anomalies. What we more especially call attention to here is, that bodies of identical chemical composition, without even a change of density in some cases (as in 2 and 5), may at the *same temperature* have different colours,—*i.e.*, may absorb light in different degrees. From this we conclude that change of colour is not due to alteration of sensible heat.

Perhaps we get a better illustration of the same fact in the behaviour of mercuric iodide. Examined spectroscopically at say 16°C ., a band of red light is transmitted, extending from B to D. This narrows as the temperature rises; in other words, there is an increase of absorption up to about 140°C . The band of transmitted light now suddenly widens, and extends to a little beyond δ . As the temperature is on the rise there is still a gradual in-

crease of absorption, but at 220°C . there is not so much light absorbed as there was at 16°C . From this we again infer that absorption of light at comparatively *low temperatures* is not dependent upon sensible heat or vibratory motion.

II. Expansion by heat—*i.e.*, decrease of density—is an all but universal law so far as we at present know. There are several exceptions, however, and many of these are among the silicates. Their anomalous behaviour is, as a rule, pointed out by the colour-change, as in the case of the zircon. This is not always the case, for there may be change of colour, as in the beryl, without alteration of density—*i.e.*, without appreciable molecular approach or recession. On the other hand, we have in olivine an example of change of density, molecular recession, without a corresponding alteration of colour. More facts of the same nature might readily be adduced, from which we infer that molar expansion or contraction is not a necessary concomitant of metachromatism.

We have, so far, excluded from our list of possible concomitants i. and ii. α : hence we are driven to the conclusion, backed by facts which space will not allow us at present to detail here, that the only necessary concomitant is ii. β ,—*i.e.*, atomic approach or atomic recession; in other words, alteration of atomic potentiality.

From the foregoing observations we learn—

- (1). That metachromatism arises from increased absorption of light with elevation of temperature, the more refrangible increment increasing at a greater rate than the less refrangible.
- (2). That the only necessary concomitant is alteration of atomic potentiality; a change from the white towards the black end of the metachromatic scale signifying atomic recession, and a change from the black towards the white end atomic approach.
- (3). That where this change of potentiality goes far enough to affect chemical attraction sufficient to induce chemical action, then, for bodies obeying the law of colour sequence, a change of colour from the white towards the black end of the scale indicates combination, and the opposite order resolution into a lower compound.

For much help received in this study of metachromatism our thanks are due to Dr. Frankland and Mr. Wm. Valentin.

ON THE ESTIMATION OF COLOUR IN WATER.

By CHARLES A. CAMERON.

IN “Nesslerising” water it has been proposed to use solutions of caramel instead of standard solutions of ammonia for the purpose of comparison. I have, as well as other chemists, found that the standard solution of caramel, even when it contains much alcohol, becomes, after a time, turbid and useless, and also that it soon changes its hue. I do not think that the use of any coloured solution is so reliable as that of the standard solutions of ammonia; but to those who prefer the former I would recommend the use of coloured discs to be employed as follows:—Fill a Nessler tube with distilled water and place it over a disc so coloured that on looking down through the column of water it may, by the reflected light from the disc, have the colour of a solution of say 0.005 gr. of ammonia per gallon of water mixed with the usual 5 per cent of Nessler's solution. A dozen discs would be sufficient; but in using them, Nessler's solution should be always of exactly the same composition. I would suggest that Mr. Sutton, who is so valuable an ally of the chemists who have not time or inclination to prepare their solutions, &c., might make a set of cylinders, discs, and solutions, in harmony with the above suggestion.

* Dr. Andrews.

† Compiled from “Some Experiments on the Density of Garnet, &c.” (Church), *Chem. Soc. Jour* vo xvii., pp. 386 and 415.

ON SOME CHEMICAL RESEARCHES ON THE
PRESENCE OF COPPER IN CAST-IRON.

By SERGIUS KERN, St. Petersburg.

It is well known that wrought-iron containing some tenths of per cent of copper is red-short; meanwhile in some of the best irons from Siberia was found from 0.01 to 0.03 per cent of copper. In some specimens of steel I found 0.2 per cent of copper; this steel was not brittle, and had been used with success for manufacturing steel axles. The presence of copper was found in several specimens of cast-iron coming from blast-furnaces of the South Oural mountains. These specimens, when examined and analysed, showed that the presence of copper in cast-iron may amount to a higher percentage than in steel or iron without altering the quality of the metal. Unfortunately it is not so with wrought-iron or steel. The specimen examined was much used for castings; it filled up the moulds beautifully, and had a very handsome appearance; fresh cut it had a dark grey colour. Under the microscope small grains of copper were easily remarked in the mass of the metal. This peculiar sample of cast-iron was carefully analysed, and the analysis gave the following average composition:—

	Per cent.
Iron	83.514
Copper.. .. .	8.123
Tin	1.252
Cobalt	0.501
Silicium	0.952
Tungsten	0.125
Carbon.. .. .	3.001
Manganese.. .. .	2.312
	99.780

While analysing some iron samples for copper I often used, in case only traces of copper could be detected, the following method:—The specimen is dissolved in hydrochloric acid, and the copper and iron are precipitated by an excess of ammonia; the mixture is boiled and filtered; the blue liquor is evaporated nearly to dryness, and the resulting residue is dissolved in sulphuric acid. Into this solution a piece of magnesium ribbon is placed, which, in case of traces of copper, is quickly covered with a layer of this metal; that is easily observed under the microscope.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS
DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 67.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

AFTER the mixture of hydrochloric acid and air has left the regulator, by its basis, it arrives in the decomposing furnace. This consists of a cast-iron box in which are nine chambers arranged in a horizontal plane, each of them provided with a grate or false bottom at its lower part. Upon this grating stand, in the first, and also in the second chamber, vertically arranged drain-pipes which have been plunged into a hot concentrated solution of 2 mols. copper sulphate and 3 mols. sodium sulphate, and then dried. The remaining chambers are filled with fragments of bricks or balls of clay (1.5 centimetres) which have been treated in the same manner with sulphates of

copper and of soda. The entire furnace is surrounded with an air jacket and this again with a screen of masonry traversed by flues, which has the object of keeping back a part of the heat which would otherwise be lost by radiation. Another portion is supplied by the heat generated in the process by the combustion of the hydrochloric acid. The above-mentioned vertical drain-pipes serve to prevent the apparatus from being choked up with oxide or chloride of iron. It has been observed that when iron apparatus is employed for generating and conducting the hydrochloric acid gas this conveys along a certain quantity of ferric chloride, from which it cannot be freed before entering the decomposing furnace. Here the iron is deposited either as chloride, or, if the formation of chlorine has already begun, i.e., as soon as watery vapour is mixed with the gases, as pulverulent oxide of iron upon the copper sulphate. This iron dust falls from the vertical drain-pipes through the grating into the space below, whence it is easily removed. It may here, however, be remarked that Deacon, according to private communications, has latterly omitted the partition walls from the decomposition furnace, by which he effects a more ready movement of the gaseous current without any disadvantage. In a Deacon's apparatus, which the author has seen at work in the establishment of Kunheim, at Berlin, the partition walls and the vertical drain-pipes had both been omitted without any detriment being observed in the course of several months' working.

After the mixture has passed through the decomposing furnace it consists of chlorine, water, nitrogen, superfluous oxygen, and unconsumed hydrochloric acid. The latter is condensed in an ordinary condensation apparatus, charged with dilute hydrochloric acid, or water, the temperature of the gases having been previously reduced by air-coolers. The gas is next freed from the accompanying water by passage through a tower filled with chloride of calcium, or, better, through a coke-tower, down which sulphuric acid flows. The gaseous mixture is then fit for absorption in the chloride of lime chambers. As a matter of course a drying apparatus is superfluous if a watery liquid is to be saturated with chlorine, as in the preparation of potassic chlorate.

(To be continued)

ON SOME AMERICAN VANADIUM MINERALS.

By F. A. GENTH.

I. Roscoelite.

I AM indebted to Dr. James Blake of San Francisco, California, for a small quantity of the very interesting mineral, which he called "Roscoelite," in honour of Professor Roscoe, whose important investigations have put vanadium in its proper place among the elements.

Roscoelite occurs in small seams, varying in thickness from 1-20th to 1-10th of an inch in a decomposed yellowish, brownish, or greenish rock. These seams are made up of small micaceous scales, sometimes $\frac{1}{2}$ of an inch in length, mostly smaller and frequently arranged in stellate or fan-shaped groups. They show an eminent basal cleavage; soft; the sp. gr. of the purest scales (showing less than 1 per cent of impurities) was found to be 2.938; another specimen of less purity gave 2.921; lustre pearly, inclining to submetallic; colour, dark clove-brown to greenish brown, sometimes dark brownish green.

Before the blowpipe it fuses easily to a black glass, colouring the flame slightly pink. With salt of phosphorus gives a skeleton of silicic acid, a dark yellow bead in the oxidising flame, and an emerald green bead in the reducing flame. Only slightly acted upon by acids, even by boiling concentrated sulphuric acid; but readily decomposed by dilute sulphuric acid, when heated in a sealed tube at a temperature of about 180° C., leaving the silicic acid in the form of white pearly scales, and yielding

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehnts."

a deep bluish green solution. With sodic carbonate it fuses to a white mass. The roscoelite which I received for investigation was so much mixed with other substances, such as gold, quartz, a feldspathic mineral, a dark mineral, and very minute quantities of one of orange colour, that it was impossible to select for analysis material of perfect purity. For this reason I have delayed the publication of my results, which were obtained over one year ago, in the hope of being able to repeat my analyses with better and purer specimens; but I now give the results of my analyses because there is no prospect of getting any more of this mineral, as will be seen from a letter of Dr. Blake, dated San Francisco, April 5th, 1876, in which he says, that the mine in which it occurs cannot be worked any farther until a tunnel has been run, and that it is quite uncertain when this will be done.

Although by no means perfect, my results approach the truth and give a fair idea of the composition of the mineral, even if the evident admixture of other minerals, varying in the different samples analysed, from about 1 to perhaps over 12 per cent, does not permit one to calculate the atomic ratio of the constituents and establish the constitution of this species. There is especially an uncertainty with reference to the quantities of silicic acid, alumina, and potassa which belong to the roscoelite, or which may have been introduced by admixtures of feldspathic and other minerals, as will appear from the results given below, which show that the mineral, when decomposed with sulphuric or dilute hydrofluoric acid generally gives only about 6 per cent of potassa, while fusion with calcic carbonate and ammonic chloride yields from 8 to 9 per cent. Some of these uncertainties could have been removed, if a larger quantity of the mineral had been at my disposal.

Particular attention was paid to the correct determination of the vanadium and the form in which it exists in the roscoelite.

The separation of vanadium is attended with great difficulties, and I have not found any of the methods of separation to give fully reliable results. This is in part owing to the incomplete precipitation of the vanadic acid, and in part to the impossibility of washing the precipitates completely without loss of vanadium. It was therefore always determined by the only method which I found to give fully reliable results—by titration with potassic permanganate.

After the separation from the other elements, the vanadic acid was reduced by hydrosulphuric acid into V_2O_4 , which, after the excess of hydrosulphuric acid had been expelled by continued boiling, was re-oxidised into V_2O_5 by the permanganate. I have satisfied myself by numerous experiments that no matter whether only a very minute quantity of sulphuric acid is present, or a very large excess, the V_2O_4 is completely oxidised into V_2O_5 by this process.

For the determination of the state of oxidation of the vanadium in the roscoelite, a quantity of the mineral was dissolved in dilute sulphuric acid in a sealed tube at a temperature of about 180°C ., and was titrated after cooling; the liquid was then reduced by hydrosulphuric acid, and after boiling off the excess of the latter it was again titrated. From the quantity of oxygen required for oxidation in both cases it was found that vanadium in the mineral is present as $V_6O_{11} = 2V_2O_3 \cdot V_2O_5$.

The determinations of the other elements were made by the usual methods.

The finely-powdered mineral was dried (unless otherwise stated) for two days over sulphuric acid, and the different samples gave the following results:—

(a.) *Purest Scales.*—The analysis was made by dissolving one portion in sulphuric acid and determining in this the quantity and state of oxidation of the vanadium, the silicic acid, and insoluble impurities. The latter were left behind in dissolving the silicic acid in sodic carbonate and gave 0.85 per cent; a second portion was decomposed by sodic carbonate and nitrate, and a third for the

determination of the alkalis by J. L. Smith's method. The V_6O_{11} given below is the mean of the two determinations. (b.) Another sample, not quite as pure as a, was analysed by fusion. (c.) Still more contaminated with impurities, was analysed by dissolving in dilute sulphuric acid in a sealed tube, &c., ca is the result of this analysis, c β after deducting 11.45 per cent of the impurities. (d.) Another sample was decomposed by dilute hydrofluoric acid; the analysis was unfortunately lost except the determinations given below; the material for this analysis had not been dried over sulphuric acid. (e.) This sample was dried over sulphuric acid for several weeks; a portion, which was decomposed by sulphuric acid, gave 5.37 per cent insoluble silicates, 0.23 per cent of gold, and 43.24 per cent of silicic acid; the V_6O_{11} was determined by difference. The results given below were obtained by decomposing the mineral by fusion:—

	a.	b.	ca.	c β .	d.	e.
Insol. silicates, quartz, gold, &c.	[0.85]	—	11.45	—	8.91	[5.60]
SiO ₂	47.69	47.82	43.46	48.60	—	46.81
Al ₂ O ₃	14.10	12.60	10.52	11.76	—	15.78
FeO	1.67	3.30	2.03	2.27	—	1.58
MgO	2.00	2.43	1.74	1.95	—	2.31
CaO	trace	trace	0.20	0.23	—	trace
Na ₂ O (trace Li ₂ O) 0.19	0.33	0.30	0.30	0.34	5.96	0.60
K ₂ O	7.59	8.03	5.35	5.98	—	8.89
V ₆ O ₁₁	22.02	21.36	20.50	22.92	—	20.16
Ignition	4.96	5.13	5.32	5.95	6.34	3.87
	100.22	101.00	100.87	100.00	100.00	

A mineral, very similar in composition, and perhaps a compact impure variety of roscoelite, is found associated with the scales. It has the appearance of a massive dark green chlorite or that of some varieties of serpentine. The analysis was made by fusion, &c., and gave:—

SiO ₂	46.09
Al ₂ O ₃	17.46
FeO	1.95
MgO	2.18
Na ₂ O	0.18
K ₂ O	8.66
V ₆ O ₁₁	17.53
Ignition	6.37

100.42

II. Psittacinite, a New Hydrous Vanadate of Lead and Copper.

In a paper on "American Tellurium and Bismuth Minerals," read before the American Philosophical Society at the meeting of August 21, 1874 (*Proc. Am. Phil. Soc.*, xiv., 223—231), I mention, on the authority of Mr. P. Knabe, a siskin green pulverulent mineral from the "Iron Rod Mine," Silver Star District, Montana, as a new "Tellurate of lead and copper." I had at that time no opportunity to examine into the merits of this mineral, having mislaid the small sample which he had sent me. On receiving a copy of my paper Mr. Knabe furnished me with several specimens, which gave me a sufficient quantity of fair material for an analysis. A qualitative examination proved it to be a hydrous vanadate of lead and copper and not a tellurate.

When I communicated this result to Mr. Knabe he gave me an interesting account of how he fell into his error. At the Uncle Sam's Lode, in Highland District, occurs with the tetradymite a siskin green mineral, which has not yet been analysed, but which appears to be a tellurate. It looks exactly like the pulverulent variety of the psittacinite from the Iron Rod Mine. When Mr. Knabe dissolved the latter in hydrochloric acid, the evolution of chlorine indicated the presence of a higher oxide; the solution precipitated with an excess of ammoniac sulphide gave sulphides of lead and copper and a filtrate, which, on addition of an acid, gave a black pre-

capitate—vanadic sulphide—which he mistook for tellurous sulphide.

Psittacinite occurs in very thin cryptocrystalline coatings, sometimes showing a small mammillary or botryoidal structure, also peruvierite; colour, siskin green, sometimes with a grayish tint, to olive green. Before the blowpipe it fuses easily to a black shining mass. With fluxes gives the reactions of vanadium, lead and copper. Soluble in dilute nitric acid, the solution yielding on evaporation a deep red mass.

As it was impossible to get any of the mineral in a pure state, I had to use coatings with quartz attached to them, sometimes contaminated with a little limonite; but these admixtures could not influence the analysis farther than very slightly with reference to the amount of water which it contains.

The following are my results:—

	a.	b.	c.	d.	e.
PbO ..	41'36	50'17	42'89	27'12	42'38
CuO ..	14'34	16'66	14'72	9'75	15'03
V ₂ O ₅ ..	14'64	19'05	15'87	9'96	15'77
H ₂ O ..	7'42	—	not deter.	—	7'25
SiO ₂ ..	15'13	—	10'10	—	15'57
Al ₂ O ₃ ..	1'29	—	3'83	—	—
Fe ₂ O ₃ ..	2'72	7'60	2'19	48'84	4'00
MgO ..	—	—	0'65	—	—
CaO ..	not deter.	—	0'15	—	—

The oxygen ratio of PbO : CuO : V₂O₅ : H₂O in the above analyses is in—

a	2'97	2'89	6'41	6'59
b	3'60	3'36	8'34	—
c	3'08	2'97	6'95	—
d	1'94	1'96	4'36	—
e	3'04	3'03	6'90	6'44
or a	1'00	0'97	2'16	2'19
b	1'00	0'93	2'31	—
c	1'00	0'97	2'26	—
d	1'00	1'01	2'25	—
e	1'00	1'00	2'27	2'12

The average of the five analyses gives the ratio of—

1'00	0'98	2'25	2'15
9'00	9'00	20'00	18'00

corresponding to—



giving the following percentage:—

PbO	53'15
CuO	18'95
V ₂ O ₅	19'32
H ₂ O	8'58

100'00

Psittacinite occurs, sometimes associated with gold, and small quantities of cerussite, chalcophyrite, and limonite upon quartz, at several of the mines in Silver Star District, Montana, especially in the Iron Rod Mine and New Career Mine, and its occurrence in these mines is looked upon as a favourable indication, for, when it is met with, the vein becomes immediately, or soon after, rich in gold. This mineral has been called "psittacinite" from psittacinus, siskin or rather parrot green.—*American Journal of Science*.

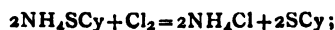
University of Pennsylvania, Philadelphia,
May 16, 1876.

PSEUDO-SULPHOCYANOGEN (CNSH).

It is well known that when sulphocyanides, more especially the alkaline salts, are treated with chlorine, bromine, or iodine, a yellow body almost entirely insoluble in water

is produced. When first obtained this substance was supposed to be the radicle sulphocyanogen, but it was always found on analysis to contain a small and somewhat variable amount of hydrogen, which excess of chlorine will not remove; hence it is termed pseudo-sulphocyanogen.

The action of chlorine, for instance, is not completely represented by the equation—



some secondary reaction taking place by which hydrogen is introduced.

From some experiments made some time ago to obtain this substance in a pure state or of a definite composition it would appear that the hydrogen is not the only element which varies in its amount in differently prepared specimens.

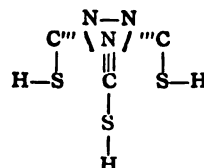
Slight variations in the temperature and strength of the solution of sulphocyanate employed producing comparatively considerable differences in the composition of the product.

When ammonio-sulphocyanate is acted upon by chlorine in excess for some days the filtrate from the yellow precipitate still gives the sulphocyanide reaction with ferric salts, and no chloride of nitrogen has been produced, even when the action of chlorine was continued on the same solution for more than a week. (NH₄Cl + Cl₂ will yield the nitrogen chloride in half an hour.)

NH₄SCy solution absorbs chlorine rapidly with rise of temperature. When the containing vessel is kept cool (10° to 15° C.) and the chlorine not used in excess a light yellow precipitate is produced, which, after washing with hot water, in which it is slightly soluble, appears to undergo a decomposition. It gave, on analysis, the following figures:—

C	20'53	(mean of two)
H	1'78	(" ")
S	53'85	(" three)
N	23'40	—

With these figures the formula CNHS agrees sufficiently well, but the tripled formula, C₃N₃S₃H₃, seems to agree better with its decomposition by heat product, mellone. The tripled formula is perhaps better written thus:—



A considerable amount of hydrocyanic acid is given off from the substance when suspended in the solution which has been submitted to the action of chlorine. But after washing and drying at 100° C. no HCy is given off when suspended in water or in dilute acids.

The pseudo-sulphocyanogen may possibly be utilised as a water or oil colour. It may be obtained of several shades of yellow and is exceedingly permanent, requiring a high temperature for its decomposition, and is not altered by the action of light either in a dry or moist condition. It is also unaffected (as far as the experiments have continued) when ground up moist with plumbic, bismuth, and argentic nitrates, and argentic sulphate. Mixed wet with solid argentic nitrite and exposed to sunlight a blackening occurs, but only due to intermixed reduced silver.

Further experiments on the action of salts on this substance aided by sunlight are in progress, and the results, with your permission, will form the subject of a future notice.

W. R. H.

Royal College of Chemistry.

ON SOME OF THE CHANGES IN THE PHYSICAL PROPERTIES OF STEEL, PRODUCED BY TEMPERING.

By A. S. KIMBALL,

Prof. of Physics in the Worcester Institute of Industrial Science.

A FEW interesting, and, to a certain extent, novel results, have recently been developed in our laboratory, which I venture to present in their present incomplete form, since the pressure of other duties will postpone, for a few months, further investigations in this direction. Up to the present time the larger number of our experiments have been made upon the behaviour of tempered bars under a transverse stress, although a few qualitative trials have been made upon changes in electric conductivity and coefficients of expansion.

I. *The modulus of elasticity decreases as the hardness of the steel increases; in other words, the harder the bar the greater the deflection produced by a given weight.*

Many manuals of practical mechanics give a higher modulus for tempered than for untempered steel. Reuleaux, in "Der Constructeur" (p. 4), states that it may be increased 50 per cent by hardening. Coulomb and Tredgold state that hardening has no influence whatever, while Styffe finds that the modulus is diminished. For our first experiment, five pieces of good tool-steel, each 13" long, were cut from a half-inch square bar. These were carefully annealed, squared, and polished. No. 1 was laid aside, and the others were hardened in cold water in the usual manner; No. 2 was "drawn" on a hot plate to a dark blue; No. 3 to a purple; No. 4 to a straw-colour; No. 5 was left hard. The modulus of elasticity was then determined by measuring the deflection produced by a weight applied at the middle of the bar. The probable error of the experiments did not exceed one-fifth of 1 per cent. The experiment was varied in many ways; several qualities of steel and bars of different dimensions were employed with uniform results. In some grades of steel a difference of more than 10 per cent has been found between the modulus of the hardened and that of the annealed bar.

II. *The increase of deflection in a given time is greater the harder the steel.*

It is well known that the deflection of a bar left under stress will increase for a long time. I am not aware, however, that comparative tests of the rate of increase in steel of different tempers have previously been made.

III. *The immediate set increases with the hardness of the steel.*

In the experiments each bar was of course loaded with the same weight, which was allowed to act for the same number of minutes.

IV. *A bar recovers from a temporary set with greater rapidity the harder it is.*

The remarkable fluctuations in the line of the bar observed by Prof. Norton (*Amer. Journ. of Science and Arts*, April, 1876) became more marked and had a wider range as the hardness of the bar increased. In none of the experiments referred to was a permanent set produced, though in some cases forty-eight hours had elapsed before the bar recovered its original line. In a few experiments an attempt was made to determine the approximate hardness of the bars by grinding. The results obtained, however, could not be considered very reliable. A more satisfactory method was found in the determination of the temperatures employed in hardening and drawing, by the specific heat of platinum, or by the use of the pyrometer.

I am indebted to Mr. F. C. Blake for the accuracy with which the experiments referred to in this note have been conducted.—*American Journal of Science and Arts*.

CORRESPONDENCE.

ON THE PRESENCE OF ARSENIC IN THE VAPOURS OF BONE-MANURE.

To the Editor of the Chemical News.

SIR,—In the *CHEMICAL NEWS* (vol. xxxiv., p. 68) you criticise a book bearing the above title. In the course of your remarks you say:—"Miasms or organic poisons could scarcely meet with a more efficient corrective than chloride of arsenic, fluorine, and other of the volatile compounds said to be given off. On the other hand, sulphuretted hydrogen and sulphide of ammonium are admirably calculated to purge the atmosphere of arsenical fumes."

I wish, as this opportunity presents itself, to lay before you a fact repeatedly observed, which seems calculated to contradict the suggestion that sulphuretted hydrogen would form a purge for an atmosphere contaminated with arsenical fumes. The same fact would throw some doubt on the other suggestion, viz., that trichloride of arsenic is a corrective for miasms and other organic poisons.

While making some experiments on the purification of hydrochloric acid from arsenic, the late Mr. Henry Deacon suggested to mix the arsenical hydrochloric acid in the gaseous state with gaseous sulphuretted hydrogen. Accordingly, some gaseous hydrogen chloride was mixed with arsentrichloride and sulphuretted hydrogen, in one case in as dry a condition as the use of concentrated sulphuric acid will permit, in another case saturated with aqueous vapour. In the one case, when the gaseous mixture was dry, no trace of sulphide of arsenic had deposited on the side of the glass vessel containing the mixture; in the other case, in which some liquid hydrochloric acid was introduced into the vessel, so that its sides were wet, a little chloride of arsenic had been decomposed and deposited as sulphide. In both instances, however, large quantities of sulphide of arsenic were formed when the gaseous mixture was driven through a wash-bottle containing water.

The experiments were repeated constantly with the same result. The conclusion is that gaseous arsentrichloride does not react upon gaseous sulphuretted hydrogen.

You will readily admit that sulphuretted hydrogen will form no purge for an atmosphere contaminated with arsenical fumes, and you will doubt with me, seeing that chloride of arsenic will not act in the gaseous state upon sulphuretted hydrogen, whether arsentrichloride will, under those conditions, correct the noxious miasms or organic poisons.—I am, &c.,

DR. FERD. HURTER.

Laboratory of Messrs. Gaskell, Deacon, and Co.,
Widnes, August 19, 1876.

PLATINUM COMBUSTION TUBES.

To the Editor of the Chemical News:

SIR,—Your correspondent, writing on the subject of platinum combustion tubes in the *CHEMICAL NEWS* (vol. xxxiv., p. 67), says:—"With a platinum tube filled with cupric oxide in the manner above described it would be possible to perform a succession of analyses; thus greatly economising time. This arrangement of apparatus is based on purely theoretical considerations. I have had no opportunities of practically testing the value of platinum combustion tubes."

I am happy to be able to supply the practical experience which C. J. H. W. lacks. In a paper on the "Determination of Carbon in Steel," published in the *Journal of the Chemical Society*, for October, 1870, I state that a platinum tube was employed, and that "I was thus saved from the annoyance caused by the fusing or cracking of

glass or porcelain tubes, and was enabled to perform combustion after combustion with the greatest ease."

Before applying the platinum tube to the direct combustion of iron or steel, "an experiment was tried with pure sugar to ascertain whether a stream of oxygen, in conjunction with a layer of only 4 inches of cupric oxide would be sufficient to convert all the carbon into carbonic anhydride. The result was perfectly satisfactory, an amount of carbonic anhydride being obtained equal to 42.086 per cent of carbon instead of 42.105, showing a loss of only 0.019 per cent upon the theoretical amount."

To prove that a platinum tube is equally applicable in the case of small quantities, I give the results of duplicate estimations of carbon in steel by direct combustion:—

1.	2.	3.	4.	5.
1.180	0.921	0.763	0.649	0.359
1.151	0.922	0.759	0.620	0.359
—	—	0.758	—	—

The expense of platinum tubes has probably militated most against their general use, but where a number of analyses has to be made this would soon be compensated for by the saving of time and glass tubes.—I am, &c.,

W. DOUGLAS HERMAN.

Cropper's Hill, St. Helens, Lancashire,
August 21, 1876.

THE PRÉSENCE OF NITRITES IN THE WATER OF THE THAMES.

To the Editor of the Chemical News.

SIR,—The following experiments were made with a view to ascertain whether nitrites of any kind existed in Thames water; but although the process employed was one capable of detecting the ten-thousandth part of a grain of any nitrite whatever, yet it totally failed in this instance to indicate even a trace. The first experiment was made upon Thames water which had been purposely allowed to concentrate in a steam-boiler until 400 cubic feet of it had been reduced to 8 cubic feet, and of this concentrated water 1 gallon was evaporated down to the bulk of 100 grains, when it was tested in this manner:—One drop of the water in question being placed on a clean white porcelain slab, a corresponding drop of a solution of the protochloride of iron was put close to it, and then the two drops were made to unite by means of a platinum wire, but no visible effect was produced in consequence of the admixture.

The water in this case had been obtained about 1 mile below London Bridge, and a precisely similar negative result was derived from water taken near Vauxhall Bridge, although the amount of concentration was then six times greater than in the first instance; consequently we cannot regard the existence of nitrites in Thames water as an established fact: and here, perhaps, it may be as well to remark technically that the nitrites in general, but particularly the nitrite of soda, possesses many advantages over the bisulphite of soda for what is called an "antichlore." It is more easily made, it is cheaper, and after being used it may be recovered by evaporation in the form of nitrate, and again converted into nitrite for repeated use. Moreover, it does not by its employment lead to the production of an acidulously destructive compound like bisulphate of soda, because the nitrite of soda, when used as an antichlore, is merely converted into a neutral nitrate, after having arrested the injurious influence of two atoms of chlorine.

Whilst upon the subject of Thames water, it is interesting to review an observation made by Berzelius, which may be found at page 686 of the fifth volume of his "Chemistry," translated into French by Valerius. After quoting numerous experiments made by Wöhler, Ehrenberg, and Morren, which prove that the effect of infusorial animals in water is to oxidise the water, and generate an air containing 51 per cent of oxygen and 49 per cent of

nitrogen, Berzelius adds—"Il semblerait, d'après cela, que le dégagement d'oxygène dans ces animaux est dû à traction du soleil sur la chlorophylle qu'ils contiennent," a singularly sagacious conclusion, and one that ought to induce those interested in water-supply to have this matter thoroughly investigated by competent individuals, for it is quite possible that the growing of water-cresses, for instance, and the purification of water are more nearly related to each other than directors of water companies imagine.

That chlorophyll performs important duties in both the vegetable and animal economy seems certain, though its powers as yet are undefined and but little understood. Still, however, we can notice that it invariably exists on the surface of the living leaves of plants, also in the bile, and sometimes in the blood of animals; and within the last two years it has been discovered that the spots and colouring found upon the eggs of birds is chlorophyll; and, in some cases, as in the egg of the hedge-sparrow, this chlorophyll is blue (which seems, indeed, to be the colour of pure chlorophyll, as will be explained on a subsequent occasion, when speaking of the composition of bile, a matter now under examination). For the present we may remark that room enough exists to warrant energetic interference on the part of our Metropolitan water directors with the closely-allied subjects of water-purity and water-jobbery; because it may so be that Nature's remedy is staring them in the face whilst they are blindly hunting by expensive methods to perform a really inexpensive operation, and thus uselessly sinking an immense capital that will have to be paid for hereafter, and therefore in all time to come limit the use of Heaven's greatest boon throughout the largest metropolis in the world. We have already seen something of this kind brought about in the case of coal-gas, the price of which in London at the present moment would not have been more than two shillings per 1000 cubic feet had matters been left to the wholesome action of common sense and honest competition. But all the benefits arising from improvements and economies in gas-making during the last twenty years has been swallowed up by expensive Acts of Parliament and engineering jobbery, so that the price remains almost unchanged, and is, perhaps, unchangeable.—I am, &c.,

LEWIS THOMPSON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. No. 4, July 24, 1876.

Observation of the Portion of the Spectrum Below the Red Ray by means of the Effects of Phosphorescence.—M. E. Becquerel.—We may follow by direct vision some of the effects produced in this region of the spectrum. We find thus merely some rather large absorption-bands, and to distinguish these it is necessary to have a very intense light. It is probable that many lines and narrower bands may escape this means of observation. The margins of the images are not well defined, except those of the region A', A'' (the more and the less refrangible parts of the spectral region below the red). On the other hand, the observations do not extend much beyond A'', and do not comprehend all the space where the thermic phenomena are observable. This may depend on the limits within which the effects of phosphorescence are appreciable, and which may not be the same as those of the thermic spectrum. The author's method is to fix a highly phosphorescent substance, such as an alkaline-earth sulphide, upon paper or glass by means of gum, and

having excited it by the action of diffused light to observe the extinction of phosphorescence produced by this part of the spectrum. This extinction causes unequally active parts to appear, *i.e.*, spaces corresponding to the black rays or bands of the spectrum.

Paraldol, an Isomeric Modification of Aldol.—M. A. Wurtz.—This compound softens at 80°, and is melted at 90°. It dissolves readily in water and alcohol, from which latter it is obtained in fine anorthic prisms.

Reply of M. Hirn to the Criticism of M. Ledieu in "Comptes Rendus," July 10, 1876.—M. Hirn complains that M. Ledieu ascribes to him the very views which he is attempting to refute.

Production of the Electric Effluve.—M. A. Boillot.—The author, in experimenting upon the chemical action of the effluve, makes use of the following arrangement:—Two narrow tubes, filled with graphite in powder and calcined, and are parallel to and near each other. They are inserted with their whole length in a test-tube about 18 centimetres in length, and they terminate each with a platinum wire communicating with the carbon. The wire from one of these tubes traverses the test-tube to its upper part; the other is bent back in a downward direction. Two other tubes enter the test-tube; the one ends at the summit, and the other penetrates to 2 or 3 centimetres of the orifice. The first is destined to introduce the gases, and the second to collect them. The effluve is produced in the space between the two carbon conductors.

Photometric Researches on Coloured Flames.—M. Gouy.—Not suitable for abstraction.

Note on the Radiometer.—M. A. Gaiffe.—The author has made a modification, which he considers proves that the actinic and thermic rays act upon this instrument. It is a radiometer of the ordinary form, the discs being coloured a dead blue on one surface and a dead red on the other. It may be made to revolve in either direction by using alternately suitable sources of heat and light. If, *e.g.*, we expose this instrument to the sunlight, the blue surfaces acquire a predominant action, and after some moments hesitation the mill begins to turn from the left to the right. If it is exposed to the flame of a common gas-jet, or of a Bunsen burner, or to the radiations of a plate of hot iron the rotation takes place in an inverse direction.

Radiometers composed of Laminæ of Different Materials.—MM. Alvergnyat Freres.—The following observations have been made with radiometers with discs of different materials. No. 1 is a radiometer with discs of silver and transparent mica. In the light the radiometer turns with the mica in front and the silver repelled; in obscure heat, with the radiometer plunged in water at 30° or 40°, the rotation is in the opposite direction. In ice it turns as if exposed to light. No. 2 is composed of aluminium and blackened mica. In the light this radiometer turns with the metal first, and the blackened surface repelled. Obscure heat and light, however intense, do not modify the direction of the rotation. If plunged in ice it turns in the opposite direction. No. 3 is formed of aluminium and mica not blackened. In light this radiometer turns with the mica first. In ice the rotation is in the same direction as in light. Dark heat makes it turn in the opposite direction, with the metal first. With this radiometer M. Jamin made the following experiment:—He directed a small light upon one point of the radiometer while in motion, so as to heat only a single point of the globe. This threw the discs into such a state of equilibrium, that instead of rotation there ensued oscillations like those of a pendulum. The two surfaces of the discs, the metal and the mica, are both repelled: if the distance of the flame is varied one of the two laminæ is repelled more or less. No. 5 is a radiometer with discs of silver and aluminium. This radiometer has been heated to 440°, distilling sulphur, and continuing to make a vacuum with the aid of the mercurial pump. The instrument was ren-

dered insensible, though it turned very quickly if a vacuum was made without heating in the ordinary manner. But if the discs, instead of being made of two metals, were made half of metal and half of mica the instrument could not be rendered insensible. The glass case was pierced by an electric discharge, when the radiometer began to turn with great speed, and continued for an hour. The aperture was so small that its diameter could be approximately estimated only by the aid of a powerful microscope. It was found practicable to re-form a vacuum in this instrument up to 100 m.m., even though perforated; rotation then took place in the ordinary manner. Nos. 6, 7, and 8, are radiometers with discs of mica and varnished copper, green, blue, red, and yellow; the colours, in these conditions, have no effect on the radiation.

Cause of the Motion of the Radometer.—M. G. Salet.—According to all the experiments made, the cause of movement in the various apparatus resembling the radiometer of Crookes is a difference in the temperature of the surfaces of the discs. The theory of Tait appears the best. A disc, compound or simple, whose surfaces have actually two different temperatures, and which is plunged into a highly rarefied atmosphere, begins to move, the hottest surface recoiling. Whilst the difference of temperature exists the movement continues. There is no occasion to bring forward the possible action of gases condensed on the surfaces. Wherever two thermometers, isolated in a vacuum, and constructed of two different substances, A and B, would indicate different temperatures, a radiometer disc composed of adjacent laminæ, the one of the substance A and the other of B, will begin to move, and the movement will show the direction and the degree of the difference of temperature. In the circle of lights the discrepancy between the indications of two thermometers, the one with its bulb blackened maintained itself for an indefinite time; it is the same with the movement of the radiometer. Not content with repeating the experiment of Mr. Crookes and M. Fizeau, by placing the radiometer in the centre of a sphere of opal glass so as to equalise the light and avoid currents of air, the author has made an experiment which he considers absolutely demonstrative. He has fixed upon the mill of a radiometer the needle of a compass: the discs were composed of two laminæ of burnt mica, one of them blackened. Under the influence of an adjacent flame the needle deviated to a certain angle, and variations in the lustre or in the distance of the flame were shown very distinctly by a corresponding change in the deviation. The source of light having remained constant for four days the needle kept its position invariable for the whole of the time. The action of condensed gases cannot be invoked here.

Decomposition of Alkaline Bicarbonates, Moist or Dry, under the Influence of Heat and of a Vacuum.—M. A. Gautier.—Perfectly pure and dry bicarbonate of soda is not sensibly decomposed in a vacuum at 20° to 25°. At 100° it is rapidly decomposed in dry air. Solutions of bicarbonate of soda in water set to evaporate in a vacuum are decomposed at 20° to 25°, and this the more rapidly the greater the quantity of the water. The bicarbonate of potassa is decomposed much less rapidly at elevated temperatures than the corresponding soda salt.

Geological Age of Certain Metallic Veins, and, in particular, of Mercury.—M. Viret d'Aoust.—The author concludes that in the Asturias, as in Mexico and France, mercury is of very modern origin.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 14, August 3, 1876.

Occurrence of the Germs of the Tape-worm in Meat.—An article taken from the *Abille Médicale* points out the danger of eating meat in the half-raw condition, called by some persons "rare," as the ova of the tape-worm are only killed by thorough cooking. Those whose

tastes lead them to select meat in this condition are recommended to eat the flesh of the horse, which is less infected by the *Tænia* than the ox, sheep, or pig.

MISCELLANEOUS.

British Pharmaceutical Conference.—(Thirteenth Annual Meeting, Glasgow, 1876. Tuesday, September 5, and Wednesday, September 6).—The following papers are already promised:—

1. "Liquid Extract of Pareira." Mr. Barnard S. Proctor.
2. "Variation in the Strength of the Preparations of Opium." Mr. D. B. Dott.
3. "Report on the Assay of Opium for Morphia." E. L. Cleaver, F.C.S.
4. "Note on the Assay of Opium." Mr. Barnard S. Proctor.
5. "New Derivatives from the Opium Alkaloids." Dr. Wright, F.C.S.
6. "The Presence of Free Acetic Acid in Opium." David Brown, F.C.S.
7. "New Excipients for the Official and other Pill Masses." Mr. G. Welborn.
8. "The Preparation and Preservation of Phosphorus Pills." Mr. T. Haffenden.
9. "Notes on some Salts of Pilocarpine." Mr. A. W. Gerrard.
10. "Report on the Aconite Alkaloids." Dr. Wright, F.C.S.
11. "The Solubility of Cinchona Principles in Glycerine." Mr. T. Andrews.
12. "The Therapeutic Value of the Aloins." Dr. Tilden, F.C.S.
13. "The Active Principle of Capsicum Fruit." J. C. Thresh, F.C.S.
14. "Report of the Oxidation of the Essential Oils." Part IV. C. T. Kingzett, F.C.S.
15. "Report on the Essential Oil of Sage." M. M. P. Muir, F.C.S.
16. "Note on the Benzoates in Suint." Mr. A. Taylor.
17. "Notes on the Colouring Matter of *Crocus Sativus*." W. W. Stoddart, F.C.S.
18. "Pekoe 'Flower'—or, Hair of the Tea Leaf." T. B. Groves, F.C.S.
19. "A New Form of Plaster of Cantharides." Mr. A. W. Gerrard.
20. "A Proposed Solution of Citrate of Iron and Quinine." Mr. J. F. Brown.
21. "Preliminary Report on the Chemistry of Ivy." R. H. Davies, F.C.S.
22. "Supplementary Note on Phosphate Syrups." W. L. Howie, F.C.S.
23. "On Filtering Papers." Thomas Greenish, F.C.S.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of alkaline sulphates. J. C. Stevenson, South Shields, Durham. May 8, 1875.—No. 1723. This invention relates to the preparation of common salt to be used in the process patented by Messrs. Hargreaves and Robinson for the manufacture of sulphate of soda by exposing common salt to the action of sulphurous acid.

Improvements in the treatment of natural substances containing phosphates of alumina. M. Prentice, Stowmarket, Suffolk. May 11, 1875.—No. 1758. This invention relates to the treatment of natural products containing phosphoric acid and alumina, and consists in subjecting such natural phosphates to the action of an alkali or alkaline carbonate, such, for example, as caustic soda, or carbonate of soda, or soda-ash, or to what is known as black-ash liquor, or to other alkaline products, such, for example, as the waste alkaline liquors from paper works, in order that the phosphoric acid and the alumina contained in the natural phosphates may be separated therefrom by being thus ren-

dered into a condition capable of being dissolved in water. Or instead of employing any of the before-mentioned alkaline compounds or products, I submit the phosphate of alumina by preference in a finely-divided condition in conjunction with sulphate of soda, coal, or other carbonaceous matter to the action of heat in order that the phosphoric acid, together with the alumina, shall be converted into a soluble condition.

Improvements in dyeing. E. T. Hughes, Chancery Lane, London. (A communication from G. C. F. Bartels and E. F. Freise, Goettingen, Hanover, Germany.) May 11, 1875.—No. 1764. This consists in chemical combination of mercaptane, which has great affinity to both vegetable and animal fibres, whereby instead of using several baths for the different kinds of fibres as heretofore, but one bath is required, and tissues of mixed fibres may be dyed with one bath.

Improvements in the treatment of animal blood, also of fibrous materials, and in the manufacture of manures therefrom. G. F. Snelling, Edith Terrace, Victoria Road, Upton Lane, Essex. May 19, 1876.—No. 1844. This relates (1) to the treatment of animal blood in special manner. (2) To the treatment of shoddy and woollen and cotton rags in a special manner. (3) To the manufacture of manures from the above ingredients, separately or combined with other ingredients, such manures containing large fertilising properties, which free themselves by or in contact with moisture alter application to or upon the soil.

Improvements in the treatment of sewage. M. F. Anderson, Priory Road, Coventry, Warwick. May 19, 1875.—No. 1845. This Provisional Specification describes drying sewage sludge by adding to it coprolite and sulphuric acid.

Improvements in deodorising blood to enable it to be used for manuring and other purposes. J. Smith, Castle Market, London, Middlesex. May 20, 1875.—No. 1855. This consists in mixing blood with suitable proportions of phosphate of lime or ground coprolites, calcic oxide, and sulphuric acid (or by preference ammonia lignine saturated with sulphuric acid), the mixture being well stirred as the different ingredients are added.

Improvements in and relating to the obtainment of phosphorus and phosphides. J. Townsend, Glasgow, Lanark, N.B. May 21, 1875.—No. 1862. This invention consists in the utilisation, as a source of the phosphorus and phosphides, of phosphate of alumina; and the kind known as Rodonda phosphate answers quite well, although other varieties will do so also.

Improvements in photometers. W. Morgan-Brown, Southampton Buildings, London. (A communication from O. Shuette, Rue Gallion, Paris.) May 21, 1875.—No. 1865. This invention consists in measuring light by interposing one or several thicknesses of slightly opaque substances, as paper, carrying increasing numbers, by which figures the relative intensity of the light is measured.

NOTES AND QUERIES.

Analysis of Water of River Hooghly.—Can any of your readers inform me if any analysis of the water of the River Hooghly, in India, has ever been published, and where it may be referred to? I desire to consult such an analysis if possible.—F. J. ROWAN.

OWENS COLLEGE, MANCHESTER.

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Professors and Lecturers.

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With Assistant Lecturers in all the Principal Departments.

THE NEXT SESSION WILL COMMENCE on the 3rd of OCTOBER. Candidates for Admission must not be under fourteen years of age, and those under sixteen will be required to pass a Preliminary Examination in English, Arithmetic, and the Elements of Latin.

Prospectuses of the several Departments of Arts, Science and Law, Medicine, the Evening Classes, and of Scholarships and Entrance Exhibitions, will be forwarded on application.

J. HOLME NICHOLSON, Registrar.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 875.

ON A NEW PROCESS FOR THE QUALITATIVE DETECTION AND THE DETERMINATION OF POTASSA.

By M. A. CARNOT.

IN spite of the improvements in the estimation of potassa introduced by Peligot and Schloësing, its exact determination in a somewhat complex substance remains one of the most delicate operations in analytical chemistry. We have, further, no reagent sensitive enough to detect its presence in small quantities.

The new reaction of the salts of potassa in presence of hyposulphite of soda and a salt of bismuth in a solution mixed with alcohol solves both these difficulties.

We dissolve in a few drops of hydrochloric acid 1 part of the subnitrate of bismuth—say half a grm.—and, on the other hand, about 2 parts (1 grm. to $1\frac{1}{2}$) of crystallised hyposulphite of soda in a few c.c. of water. The second solution is then poured into the first, and concentrated alcohol is added in large excess. This mixture is the reagent.

If brought in contact with a few drops of the solution of a potash-salt it at once gives a yellow precipitate. With an undissolved potassic salt it produces a decidedly yellow colouration, easily recognised.

All potassic salts with mineral acids are equally susceptible of this reaction, sulphates and phosphates as well as nitrates, carbonates, chlorides, &c. It is also very sensitive with the organic salts, tartrates, citrates, &c.

The reaction is not interfered with by the presence of other bases with which nothing analogous is produced. The character is, therefore, perfectly distinct.

Baryta and strontia alone may occasion some difficulty, by reason of the white precipitates of double hyposulphites which they form with the same reagent; but it is very rare to meet them along with potassa, and they are very easily detected and removed.

If we have a solution containing merely a few milligrams of potassa, it is reduced by evaporation to a very small volume, or even to dryness, when the characteristic reaction readily appears. Or slips of filter-paper may be repeatedly saturated with the dilute solution, and after drying be steeped in the alcoholic reagent, when the yellow colour will appear, especially on the margins of the paper.

The author's quantitative experiments refer chiefly to nitrates, chlorides, and mixtures of the two salts. With some special precautions the method may probably be applied directly to sulphates, though these are easily converted into chlorides by chloride of barium, removing the excess of baryta with sodic or ammoniac carbonate.

The hyposulphite of commerce is sufficiently pure for use; the crystals are dissolved in a small quantity of water at the moment of the experiment.

The chloride of bismuth is prepared by treating the pulverised metal with a few drops of nitric acid, evaporating to dryness, and then heating with a very small quantity of hydrochloric acid. The lead possibly present in the bismuth is got rid of by adding to the cold solution concentrated alcohol, which causes chloride of lead to be deposited. Or subnitrate of bismuth may be dissolved in a few drops of hydrochloric acid.

The liquid in which the potassa is to be determined should not exceed 10 to 15 c.c. in bulk, so that the entire volume of the aqueous solutions may not exceed 20 to 25 c.c. For 1 part of supposed potassa we take 2 parts of

bismuth or $2\frac{1}{2}$ of subnitrate with 7 parts of crystalline hyposulphite.

The solution of the potassic salt is placed in a small flask, the bismuth solution is added, then the hyposulphite, the whole is mixed rapidly, and 200 to 250 c.c. of concentrated alcohol are added. The whole is agitated for a few moments, and left to settle. The yellow precipitate collects at the bottom of the flask, and may be filtered after a quarter of an hour, and carefully washed with alcohol.

The precipitate cannot be weighed; it is dissolved upon the filter in excess of water; the bismuth is thrown down as sulphide by sulphhydrate of ammonia, washed by decantation, collected on a tared filter, dried at 100° , and weighed. The weight obtained may be corrected by separating from the filter a part of the dried precipitate, and heating it again to 150° to 200° in a small platinum crucible, weighing before and after, and correcting the total weight of the sulphide accordingly. The weight of the potassa is found on multiplying the weight of the sulphide of bismuth found by—

$$\frac{3\text{KO}}{\text{Bi}_2\text{S}_3} = 0.549$$

The method has been found accurate in presence of soda, lithia, ammonia, lime, magnesia, alumina, and iron.—*Comptes Rendus.*

NOTICE ON THE OIL OF WOOD.

By M. GUIBOURT.

THIS curious product of India, called by the English *wood-oil* or *Gurjun balsam*, forms already the subject of two papers published in the *Pharmaceutical Journal*, by Messrs. Charles Lowe and Daniel Hanbury. Mr. C. Lowe, who only knew that this resinous liquid is extracted in India, by incisions made in the tree, considers it as a *Copaiva balsam* rendered turbid by a greenish resin held in suspension. The filtered balsam forms a brown and transparent liquid, from which we withdraw by distillation—

Volatile oil	65
Hard resin	34
Water and acetic acid	1

According to Mr. Lowe the volatile oil possesses all the characters of that of *copaiva*, and the *hard resin*, which he regards as pure *copaivic acid*, free from the *soft resin*, which, according to him, exists in the most part of commercial *copaivas*, seemed to him to indicate a superior quality as a medicine. I avow that I scarcely understand this conclusion, and that I am so much the less convinced of the identity of the hard resin with *copaivic acid* as Mr. Lowe has observed in the new resinous balsam the singular property of solidifying when exposed, in a closed vessel, to a temperature of 230° F.; *copaiva* presents nothing similar. I find further this difference, that the new balsam distilled with an addition of a little quantity of an oxidising body as chlorine, hypochlorite of lime, or bichromate of potash, furnishes an essence of a beautiful blue colour, whilst common *copaiva* with soft resin scarcely furnishes any coloured essence. The notice concludes with a mention of a falsification which appeared to me at once ill-founded and little to be feared; it is that cold sulphuric acid produces with *copaiva* a purple colouration like that obtained with cod-liver oil, to such an extent that dishonest persons might sell a mixture of *olive oil* or any other fatty oil with a little quantity of *copaiva* for cod-liver oil. Mr. D. Hanbury tells us in his notice that oil of wood is extracted from *Dipterocarpus turbinatus* by quite a peculiar process, which I shall describe in a few words, in order to make the nature of the product better known. To obtain it a large incision is made in the trunk of the tree, about 30 inches from the ground, upon

which they kindle and maintain a fire so that the incision may be charred; soon after the liquid begins to run. It is conducted by means of a little gutter, into a vessel destined to receive it. The average yield of the best trees during a season is from 30 gallons, &c. Roxburgh adds that oil of wood is also produced by the *Dipterocarpus incarnus*, *alatus*, and *costatus*. The first is reputed to furnish the best sort and in the largest quantity. Oil of wood, which makes the object of Mr. Hanbury's notice, has been imported in a large quantity from Moulmein, in British Burmah. When filtered it forms a transparent liquid of a very deep brown by transmitted light, but it seems opaque and of an obscure green when seen by reflection. It possesses then in a very marked degree the dichroism observed in all resinous oils obtained by fire. I insist on this character, which settles the nature of the wood-oil, which is not simply a natural product like copaiva, but which results, in part at least, from a liquid modification of the resin of *Dipterocarpus* obtained by the action of fire. This oil of wood from Moulmein is more consistent than olive oil; it weighs 0.964, and possesses an odour and a taste very analogous to copaiva. It dissolves in twice its own weight of absolute alcohol, with the exception of a little quantity of matter which is separated on standing. But the most curious property of this oil, already noticed by Mr. Lowe and observed anew by Mr. Hanbury, is that it solidifies when heated in a stoppered vial at 266° F.; at this temperature the oil becomes turbid and so gelatinous that it is not displaced by the inversion of the vessel. After cooling the solidification becomes more complete; but a gentle heat aided by a slight agitation re-establishes its former fluidity. Mr. Lowe had indicated the temperature of 230° F. for the solidification of wood-oil. I suppose that the difference of temperature pointed out by the two observers depends on that of the liquids upon which they have operated; for just as the copaiva furnished by various *copaifera* of America, or the turpentine produced by the different species of pines and firs, are not identical, it is very reasonable to think that the oils of wood furnished by *Dipterocarpus turbinatus*, *incarnus*, *alatus*, *costatus*, &c., are not absolutely alike; the higher or lower temperature which the oil has undergone may be also a cause of variation in the properties of the product. What I say here is not a supposition; it is a fact at present certain. In the Universal Exhibition of 1855, there were two samples of wood-oil, one coming from *Canara* the other from *Tenasserim*. One of these samples, I do not know which, contained in a little pot of white earthenware which, of an intermediate grade between stoneware and porcelain, had been given by Dr. Royle to M. Delasse, a member of the International Jury, charged to give a report on the bitumens and petroleum admitted to the Exhibition. M. Delasse, not finding there what he sought, sent back the sample, which I judged in consequence ought to be the new *copaiva* announced by Mr. Lowe. It approximates, in fact, much more to the balsam examined by Mr. Lowe than to that for which I am obliged to Mr. Hanbury. The wood-oil of Mr. Hanbury has nearly the liquidity of olive oils; if placed between the eye and the sun it is completely transparent and of the colour of dark Malaga wine; by reflection it seems opaque and of an olive green. It behaves with ammonia and magnesia in a very different manner from copaiva. Mixed with liquid ammonia at 22° B., in the proportion by weight of 5 parts of balsam to 2 of alkali, it forms immediately an opaque and very thick mixture which does not change by time. It is not solidified by 1-16th of calcined magnesia; the two substances separate on standing. The wood-oil of M. Delasse has the aspect of a thick and slightly gelatinous liquid. After having deposited a little green resin, which is held in suspension, it becomes almost transparent; if placed between the eye and the sun it is of a very deep red; if seen by reflection it appears still red but turbid, and resembles a liquid in which fine powder of cochineal has been suspended by agitation. The complementary

colour of the red does not then appear, but it becomes manifest when, after agitation, a thin layer of the liquid covers the upper side of the bottle. Then in whatever manner we look at this layer there appears a beautiful green colour. The same green colour appears again and becomes permanent when, after having dissolved the wood-oil in alcohol, we leave the liquid to spontaneous evaporation; we then see towards the top of the capsule, between the parts of green resin, white radiating tufts belonging to a particular principle of which I leave the examination to those who have a larger quantity of the material at their disposal. As for the resin it has acquired a permanent green colour, which we find in a dry resin which remains when we boil wood-oil and water for a very long time. This green colour which is also that of the beautiful resin of Piney (*Vateria indica*) which was seen in the Exhibition, establishes a point of comparison between two products which come from trees belonging to the same family, the *Dipterocarpeæ*; but the resemblance stops there, for the resin of the *Vateria indica* is insoluble in alcohol and very imperfectly soluble in ether, whilst the green resin of the wood-oil is easily soluble in these two mediums. Finally, the wood-oil derived from the Exhibition behaves like copaiva with ammonia and calcined magnesia. It is solidified very promptly with 1-16th of calcined magnesia, and its mixture with ammonia becomes again liquid and tolerably transparent after a momentary opacity. I am far from concluding with Mr. Lowe that the two oleo-resinous bodies are chemically identical; but with regard to their medical uses I think that all the turpentine and balsams, liquids or even solids, can be useful as remedies for the catarrhal state of the mucous membranes. I conclude by saying that the wood-oil of Mr. Hanbury and that derived from the Exhibition have not probably been extracted by the same method. The first has been obtained by the aid of fire, by the process described by Roxburgh; this second has, without doubt, been obtained without the intervention of this agent, for I do not find the characteristic features of oils which result from the action of fire on resin.—*Journal de Pharmacie et de Chimie*.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 78.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

For the latter purpose Kunheim utilises the chlorine obtained on Deacon's method. The chlorine is here so completely absorbed by the milk of lime through which it passes that mere traces are contained in the air escaping from the exhauster. The draft in the entire apparatus is kept up by any aspiratory arrangement beyond the chloride of lime chambers and measured by an anemometer constructed by Hurter. The latter consists of a U-tube of 5-16ths c.m. internal diameter, with legs about 25 c.m. in length. As one leg of this tube is always in communication with the gaseous current, the pressure occasioned by the current is always shown in the other leg by the tube by the displacement of a liquid therein contained (ether). The U-tube is fixed so that the leg containing the liquid lies flat on a graduated inclined plane, which may be raised or lowered on a frame fitted with a level. The meniscus of the liquid is thus extended diagonally, and the small vertical divisions of the scale are magnified into long horizontal degrees. Kunheim uses a simple upright U-tube filled with ether.

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

The greatest practical difficulty in the Deacon's chlorine process lies in the enormous volume of gas which has to be dealt with, and consequently in the large dimensions required for the chloride of lime chambers. But Deacon has endeavoured to combat these difficulties. He compels the gases to take such a course that they are systematically deprived of chlorine. They meet at first with chloride of lime almost saturated, then, as they lose their chlorine they pass over lime less and less chlorinised till they finally pass out into the atmosphere completely exhausted over fresh hydrate of lime. The arrangements by which this systematic saturation of the lime is produced are of a twofold nature. In the first place chambers are employed in which the lime lies on gratings and which are so connected with each other that the chlorine streams through them successively. As soon as the lime in the chamber nearest the generating apparatus is saturated it is thrown out of connection with the current of chlorine, is charged with fresh lime, and takes its place at the end of the series, whilst a chamber containing lime nearly saturated receives the concentrated portion of the gaseous current. The second kind of methodic saturation is the following, in which is applied the principle of Hasenclever and Helbig's pyrites furnace:—

In a tower are several stories of sloping plates of slate, forming a smaller angle with the perpendicular than the outer surface of the heaped up chloride of lime is capable of taking. In every story the direction of the plates, which are parallel to each other, cuts the plane of the plates, likewise parallel to each other, in the next higher and next lower story. Thus intervals are produced which extend in zigzag from below upwards. At the lower end of each of these intervals is a shovel-wheel by whose revolution the speed of a powder sliding over the plates can be regulated. Into this tower the lime is thrown by means of a hopper and slips from plate to plate till its further fall is stopped by the rollers. But as the falling lime cannot form so acute an angle with the perpendicular as the plates it does not completely fill the interstices, but leaves in every link of the zigzag a wedge-shaped space, through which the gases are compelled to ascend from stage to stage. Hence, as the lime moves constantly downwards in an opposite direction to the current fresh lime enters above, and saturated chloride is taken out below. To obviate incidental stoppages in the motion of the lime there are here and there in the tower openings fitted with valves. This apparatus can scarcely be adopted in practice, as chloride of lime, from its tendency to clog together, moves but slowly down an inclined plane, whence frequent stoppages would be inevitable.

The last mentioned apparatus, suitably modified, is recommended by Deacon for the preparation of salt-cake from diluted chlorine, sulphurous acid, steam, and salt. Instead of lime he causes salt to glide down a tower strongly heated, whilst a mixture of diluted chlorine, sulphurous acid, and steam ascends.

The hydrochloric acid thus formed is condensed and re-converted into chlorine, whilst the sulphuric acid formed by the oxidation of the sulphurous acid converts the salt into sulphate.

(To be continued)

ARAGONITE ON THE SURFACE OF A METEORIC IRON, AND A NEW MINERAL (DAUBREELITE) IN THE CONCRETIONS OF THE INTERIOR OF THE SAME.

By J. LAWRENCE SMITH, Louisville, Ky.

I. Incrustation of Aragonite.

THE remarks in this communication have reference to some of the masses of iron that have been brought from that region of Mexico called the *Bolson de Mapini*, or the Mexican Desert, situated in Cohahuila and Chihuahua,

two of the northern provinces of Mexico; the Deser being 400 miles from east to west, and 500 miles from north to south, bordering on the Rio Grande. This region, so prolific in masses of meteoric iron, has been described by Prof. Burckhardt, of Bonn, as well as by myself.

In 1854 I described three of the masses (*Amer. Journ. of Science and Arts*, vol. xxviii., p. 409): two of these have been brought to the United States, one weighing 125 kilogrms. and the other 630 kilogrms. In 1868 eight others were brought to this country, the heaviest weighing 325 kilogrms. These I described in 1869 (*Amer. Journ. of Science and Arts*, Nov., 1869); and in 1871 I was enabled to give a description and an analysis of a still larger one, weighing about 3500 kilogrms., this last one remaining on the western boundary of the Desert near El Para.

We have some account of one even larger than the last, located in the very centre of the Desert. So far as known there have been found in this locality not less than 15,000 kilogrms. of meteoric matter, an amount exceeding that which has been brought together in cabinets from all other sources.

When I examined the eight masses in 1868, I noticed a white crust on a small part of the surfaces of two of them, but at that time I could not make any critical examination of it. Within the past few months these iron's have come under my control, and therefore I have been enabled to examine the points that had been omitted, the most interesting of which forms the subject of this communication.

On one of these masses of iron, weighing 210 kilogrms., there is a small amount of a white incrustation covering about 15 square centimetres of the surface; and on another, weighing 275 kilogrms., there is an incrustation, which covered originally over 200 square centimetres of the surface, attached firmly to the iron, and when broken off (as most of it has been by careless handling of the mass) it brings away with it on the under surface a portion of the iron that has become oxidised: its thickness is from 1 to 5 m.m.

It is quite hard, scratching calc spar very readily; the surface of it is irregular and granular. If broken perpendicularly to the surface of the iron, and ground down, it will receive a very good polish, showing an irregular and wavy structure on many of the pieces, and parallel to the surface of the iron, with yellow and dark brown streaks like the Gibraltar limerock; it effervesces with acids, and is an incrustation of aragonite.

The following is the composition of the mineral:—

Carbonate of lime	93.10
Sesquioxide of iron	1.00
Magnesia	trace
Insoluble residue	4.60
Water	1.00

As regards its formation, I am satisfied that the crust has been made on the iron since the fall of the latter. Conceiving this to be the case, I desired to know the nature of the rock and soil where these meteorites were found, and I have been able to gather the following particulars from Dr. Butcher, who collected the specimens under examination:—This spot is in an alluvial valley or plain between two ranges of high mountains running parallel with each other, varying in distance from 1 to 3 miles. The mountains at the base are calcareous in formation, and in the hills and plains there are large calcareous deposits. The plain in many places is cut up with deep ravines, and several of the specimens of iron were found among the stones and sand at the bottom of the ravines, and during heavy rains were washed or covered with water. It is, however, only in wet seasons that the water is found remaining in the ravines and depressions of the valley, and this water is always brackish to the taste, containing a large amount of mineral matter.

Without giving any further details of the nature of this region of Mexico where these meteorites were collected,

sufficient has been stated to show the probable source of the calcareous incrustation which I discovered upon two of them.

This incrustation on meteorites has been discovered but twice before, and in both instances by myself. One of them, however, is of so obscure and unsatisfactory a character that I have not given any public notice of it. The other is the case of the Newton County meteorite described by me (*Amer. Journ. of Science and Arts*, vol. xl., 1865). It is a meteoric stone belonging to the variety classified by M. Daubr  e as Syssid  res; specimens of it have been furnished by me to the museums of the Garden of Plants, Great Britain and Vienna, with this incrustation in well-defined particles of a translucent character adhering firmly to the surface. The entire amount of this meteorite yet known does not exceed 700 grms., although the primitive mass must still exist in a sparsely settled region of Arkansas, and when obtained will no doubt furnish specimens with a larger amount of the calcareous incrustation upon it.

II. *New Meteoric Mineral, Daubr  elite.*

Two of the masses of iron above referred to have been cut across, the section made on one of them being over 15 square decimetres; also several transverse cuts have been made. In all of these sections a number of nodular concretions have been exposed, most of them quite small, and hardly any exceeding a centimetre in diameter. At the first glance all these nodules have the appearance of very finely crystallised troilite; but a little closer inspection reveals the fact that most of these nodules have more or less of a black mineral associated with it. I had never seen anything of the kind before, it being very evident that it was not graphite. As further examination has proved it to be a new and interesting mineral, I have thought proper to designate it after M. Daubr  e, who has done so much in the study and elucidation of meteoric minerals.

Daubr  elite is a black lustrous mineral, highly crystalline in structure, occurring on the borders of the troilite nodules, and sometimes running across the centre of them, as may be seen in one of the specimens, where, in a nodule of troilite, a vein of the mineral traverses the very centre of the nodule, which is 2 m.m. in width and 12 m.m. long. It has a distinct cleavage, but I cannot make out its crystalline form. It is very fragile, and in the attempt to detach it from the iron it breaks up into small fragments resembling small particles of molybdenite. It is feebly attracted in very fine particles when a strong magnet is brought in contact with it. This may arise from the presence of a minute quantity of troilite, which it is very difficult to get rid of. Pulverised, it furnishes a perfectly black powder, the smallest particle of which gives before the blowpipe a very strong reaction of chromium. Heated very intensely, it loses its brilliant colour and becomes a dull black.

The powdered mineral is dissolved completely in nitric acid. The solution is intensely green, and furnishes a strong reaction of sulphuric acid and oxide of chrome. The other strong acids attack it but slightly.

This solubility in nitric acid readily distinguishes it from chrome iron. The quantity of mineral I was enabled to obtain pure, or nearly so, was very small. The reaction of the acids on the mineral being nearly the same as on troilite. I am enabled to separate them only by varying the strength of the acids, and the length of the time they are in contact with the minerals.

Less than 100 m.grms. were obtained of sufficient purity to make out its composition, and this amount furnished me 36.48 per cent of sulphur; the remainder was chrome, with nearly 10 per cent of iron and a little carbonaceous matter. This mineral, when obtained pure and in sufficient quantity for a thorough analysis (which I hope to make before long), will, I am satisfied, prove to be a protosulphide of chrome; the iron present being mixed with the Daubr  elite. The following, therefore, would

express its true composition:—Sulphur, 37.62; chrome, 62.38.

This mineral is an interesting one, and is found in a very strange place; yet from what is revealed to us by the spectroscopic with regard to the vapours surrounding the sun, the element chrome must be widely diffused in the matter of the universe.—*American Journal of Science and Arts.*

ON DINITRO-PARA-DIBROMBENZOLS AND THEIR DERIVATIVES.

By PETER TOWNSEND AUSTEN.

Two kilograms of pure crystallised solid (para) dibrombenzol were divided into portions of 250 grms., and each portion added to a mixture of 800 grms. of fuming nitric acid and an equal volume of concentrated sulphuric acid, and then heated on a sand-bath, when a violent action set in, during which it was found advisable to remove the burners. A reddish yellow oil settled in the bottom of the flask. After boiling three hours the mixture was allowed to cool, and then poured in a thin stream into a large excess of cold water. The oil sank to the bottom and gradually solidified, an operation which may be greatly accelerated by vigorous stirring with a glass rod. The nitrated product from 500 grms. of the dibrombenzol, after the washing out the acid with water, was dissolved in about a kilogramme of glacial acetic acid, filtered, and allowed to stand about seventy hours. A copious separation of the first (α) dinitro-para-dibrombenzol, containing a considerable amount of the second (β) isomer, and but a small amount of the third (γ), took place. By repeated crystallisation, first from carbon disulphide and then from glacial acetic acid, it was obtained perfectly pure. The acetic acid filtrate from the first separation contained the β - and γ -isomers and some of the α . The solution was treated with a large excess of water, and the substances in solution were thus precipitated in the form of a yellow oil, which was then separated from the water by means of a stop-cock funnel, heated on a water-bath until it was entirely dry, dissolved in about 1½ kilos. of carbon disulphide, and allowed to stand. By standing, a small separation of impure α -isomer generally occurs. The carbon disulphide was then distilled off in portions of 200 c.c., and the respective crystallisations, which consisted of the β -isomer containing a good deal of the α -isomer and traces of the γ , collected. When no more separated the thick oil was heated on a water-bath until the carbon disulphide was entirely volatilised, after which it was exposed to a temperature of 5° for three days, when it became solid. The mass was carefully rubbed in a mortar with ether, at the same temperature, and this ethereal extract (consisting of much γ and little β) separated by a filter-pump. The ether was then evaporated, the oil again exposed to the same temperature, and the operation repeated until the substance dissolved in the ether without leaving a residue. The oil was then exposed to a temperature of about -8° to -10° for nearly two weeks, during which small amounts of the β -isomers crystallised out, and were separated by filtering the oil directly with the filter-pump. Finally no more separated from the oil, which then appeared to contain only an exceedingly small amount of the β -isomer.

Alpha-dinitro-para-dibrombenzol.

The alpha-dinitro-para-dibrombenzol, containing traces of the β -isomer, crystallises from glacial acetic acid in beautiful striated transparent needles, often attaining a length of 25 c.m. and a diameter of 3 m.m. When perfectly pure, however, it crystallises from the same solvent in short, compact, white, glittering needles, or small prisms. From carbon disulphide it separates in the form of small, hard, white crystals. The compound is inso-

luble in water, easily soluble in boiling absolute alcohol and glacial acetic acid, as well as in benzol and acetic ether. It is slightly volatile in steam. Fuses at 159° to a transparent slightly yellow liquid.

0.3034 grm. substance gave 0.0190 H_2O and 0.2452 CO_2 .

0.1749 grm. substance, after the method of Carius, gave 0.1998 AgBr and 0.0027 Ag.

Calculated for $C_6H_3(NO_2)_2Br_2$:

	Found.	
	I.	II.
C = 22.08	22.04	—
H = 0.61	0.69	—
Br = 49.08	—	49.74

Nitro-para-dibromaniline.

In a preliminary notice* I mentioned that α -dinitro-para-dibrombenzol, by treatment with ammonia, formed a dinitro-bromaniline, which under the influence of amyl-nitrite gave a dinitro-monobrombenzol. By repetition of the experiments, however, with much larger amounts and perfectly pure substances, I find that the reaction is different.

By treating the α -dinitro-para-dibrombenzol with strong alcoholic ammonia the crystals take on a light straw-yellow colour. By heating in a closed tube at 100° for three hours the reaction is completed. The red solution obtained was precipitated with water, and the resulting yellow precipitate crystallised from dilute alcohol. The filtrate from the precipitate produced by water gave no trace of bromine with silver nitrate, but starch and potassium iodide proved the presence of a considerable amount of nitrous acid.

By repeated crystallisations from alcohol the substance was obtained pure. It forms orange, yellow, and red needles, which fuse at 75° , and are quite volatile with steam. It is very soluble in most solvents, with the exception of water, in which it dissolves with difficulty.

0.28 grm. substance, third crystallisation, gave 0.0426 H_2O and 0.2536 CO_2 .

0.2092 grm. substance, fifth crystallisation, gave, after the method of Carius, 0.2644 grm. AgBr and 0.0008 Ag.

Calculated for $C_6H_3Br_2(NO_2)_2.NH_3$.

	Found.	
	I.	II.
C = 24.32	24.69	—
H = 1.01	1.65	—
Br = 54.05	—	54.06

Amyl-nitrite acts at ordinary temperatures on the nitro-para-dibromaniline, and forms, not as I formerly supposed, a dinitro-monobrombenzol, but the ordinary mononitro-para-dibrombenzol. All the properties of the nitro-dibrombenzol (fusing-point 84°) obtained in this manner agreed perfectly with those of the well-known mononitro-para-dibrombenzol.

This, as far as I know, is the first case in which the nitroxyl of a nitro-haloid-benzol is substituted by the amido-group in preference to the haloid atom. In the first series there is, among others, the well-known formation of guanidine from nitro-chloroform by action of ammonia, effected by Hofmann.†

It seemed extremely improbable that aniline could act in a satisfactory manner on the α -dinitro-para-dibrombenzol, since the disengaged nitro-group would, without doubt, exert a decomposing influence on the aniline itself as well as on the new compound formed. The dinitro-dibrombenzol was treated with an excess of aniline, and the mixture boiled. A strong reaction, attended with a characteristic deep red colour, occurred. Chlorhydric acid precipitated an oil, and, by stirring, brown flocks were obtained. The product was soluble in

alcohol with a deep red colour, but separated from the solution as a slimy mass from which no product susceptible of analysis could be obtained.

By the action of sodium-hydrate solution on the α -dinitro-para-dibrombenzol I have obtained a substance forming red salts, which I take to be a nitro-bromphenol, and concerning which I shall, at the earliest opportunity, give full particulars.—*Amer. Journ. of Science and Arts.*

Royal Laboratory of Berlin.

NOTICES OF BOOKS.

The Textile Colourist. Edited by C. O'NEILL, F.C.S.
Vol. I. Manchester: Palmer and Howe.

THIS is the first half-yearly volume of a monthly paper whose object, as declared in the introductory notice, is "to give an account of what is doing or has been done by practical or scientific men in connection with the dyeing, printing, bleaching, and finishing of textile fabrics and materials." Its editor remarks that "some of the existing journals do give a little space to articles connected with textile colouring," which is certainly not overstating the truth.

Among the most prominent articles we may notice "Critical and Historical Notes upon Turkey Red" taken from the *Moniteur Scientifique Quesneville*, manuscripts of Jehan le Begne, a work on dyeing compiled as early as 1431, and giving an interesting account of the tinctorial arts as practised at that time. It proves that a species of calico-printing was in use in London as early as 1410. The translation, executed by Mrs. Merrifield, must have been a task of no small difficulty as the receipts are given in old French with notes in Latin, doubtless of the mediæval type. In one of the receipts quoted we find mention of "Brazil." The red wood then used cannot, of course, have been obtained from South America, but must have been the product of some Asiatic *Casalpinia*. There is also a list of British and Irish calico printers in 1840, and a paper on the "Manufacture of Carmine or Extract of Indigo," from *Dingler's Journal*. We regret to see the continental solecism of applying the term "carmine" to preparations of indigo adopted in an English journal, sometimes even without the qualifying word "indigo." The expression "English sulphuric acid" used on the Continent to express ordinary sulphuric acid in contradistinction to the fuming or Nordhausen kind is unusual in England. The term in general use is "oil of vitriol."

We hope that the existence of the "Textile Colourist" may be considered as a proof of a widening and deepening interest in applied science.

A Course of Practical Chemistry Arranged for the Use of Medical Students. By W. ODLING, M.B., F.R.S.
London: Longmans, Green, and Co.

WHEN a scientific text-book has reached its fifth edition the duties of the critic lie in a very narrow compass. That this manual treats of chemical reactions, chemical manipulation, qualitative analysis, toxicology, and animal chemistry, with especial reference to the requirements of medical students and of the medical profession, is generally known. That it has been found satisfactory by professors of the science may be inferred by the demand for so many editions. The present re-issue, we are told, has been carefully revised, the chapter on general analysis by Dr. John Watts, and those on toxicology and animal chemistry by Dr. T. Stevenson. "In the analytical chapter of this fifth edition, brief, but it is believed for ordinary purposes sufficient, directions are now given for the separation of the several sub-groups of bases from one another, and for the recognition of the several members of these sub-groups in presence of each other."

* *Ber. d. Chem. Ges.*, viii., 1183.

† *Ann. Chem. Pharm.*, cxxxix., 107.

We cannot, however, approve of the omission of so many of the elements from the plan of the work. It may be argued that as these substances occur neither in medicines nor in articles of food, and are not likely to be employed whether accidentally or maliciously as poisons, a knowledge of their reactions and their detections is of no direct value to the medical man. This is, however, we submit, a somewhat narrow view of the subject. Furthermore, new substances are continually pressed into the service of manufacturing industry and may become the subjects of toxicological inquiry. To take an instance:—Vanadium and its compounds were till lately amongst the rarest of laboratory curiosities. Now they have been introduced into dye and print works and may fall into the hands of those ignorant of their highly poisonous nature. Is not a knowledge of the properties of vanadium and the method of its recognition likely to become of importance to the medical practitioner?

Bulletin of the Bussey Institution. Part V., 1876. Cambridge (U.S.): Wilson and Son.

MOST of our readers are doubtless aware that the Bussey Institution is an establishment connected with the Harvard University, and having for its object the cultivation of chemistry, physics, and biology with reference to agriculture. Its Bulletin is always rich in interesting articles on the composition of soils, manures, and plant-ashes; on the practical effects of manures; on the diseases of cultivated plants and of cattle; and kindred topics of the highest value both to the practical farmer and to all who devote their attention to agricultural chemistry and physiology. The Institution is evidently doing useful work, and we wish it a long and successful career.

Hunyadi János; Aperient Natural Mineral Water. By ALOIS MARTIN, M.D. London: W. Ridgway.

MINERAL waters are evidently in some quarters coming into increased demand, and very persevering efforts are made to bring certain kinds under public notice. The water in question is obtained from certain springs at Buda, and contains 137.9 grs. of sulphate of magnesia, and 128.9 grs. of sulphate of soda per gallon, proportions said to exceed those found in all other known bitter springs. Its physiological action and therapeutic applications are discussed, and it is strongly recommended by high medical authorities in a variety of ailments.

Wine and its Counterfeits. By JAMES L. DENMAN, 20, Piccadilly, London.

WE have here a pamphlet which all wine drinkers should read and remember. The author points out clearly and truthfully the real and unpleasant nature of those concoctions known as port and sherry which were forced upon the nation by an unsound system of duties during the latter part of the 18th and the beginning of the 19th century. The "plastering" process, i.e., the addition of sulphate of lime to the grapes—an operation practised for some mysterious reason upon all sheries—he holds up in its true light as utterly destructive of all real vinous flavour. How any man can drink a liquid containing more than an ounce of an alkaline sulphate per gallon, how he can call the mixture wine and profess he likes it, are to us mysteries inscrutable. Would it not be better to send us the wines pure and allow those consumers who admire the flavour of "Epsoms" or "Glaubers" to add these delicious ingredients to their own liking. While Mr. Denman, however, denounces "plaster," he is no friend to the recently patented deplastering process. It is no doubt possible to ascertain by careful analysis the exact quantity of sulphate of potash present in sherry, and to add tartrate of baryta till all the sulphuric acid is precipitated. But suppose that by some inadvertence a slight excess of baryta remained in the solution! The

remedy would be found much worse than the disease. The true method of dealing with plastered and fortified wines is to let them severally alone till Andalusian vine-growers banish gypsum from their premises and give us the pure blood of the grape.

Among the genuine, natural wines now coming into use in England, at least, among those who seek in the glass flavour and not intoxicating power, a high rank belongs to those of Greece. Mr. Denman deserves great credit for his persevering attempts to bring them under the notice of the public. No part of the world is better adapted for the cultivation of the grape than the "Isles of Greece," and the wines imported thence are worthy of their old classic fame.

CORRESPONDENCE.

THE FLAME OF CHLORIDE OF SODIUM IN A COMMON FIRE.

To the Editor of the Chemical News.

SIR,—Some time ago a correspondent of *Nature* (No. 328 Feb. 10, 1876) enquired for an explanation of the fact that while common salt (chloride of sodium) colours the flame of an ordinary spirit-lamp yellow, the same substance thrown upon a common coal fire gives rise to a blue flame. In the next number (329) Dr. Schuster stated that the origin of the blue flame was still involved in mystery, and—if my memory is correct, for I have not the number at hand—that he and Dr. Schorlemmer had been engaged on an investigation of the same.

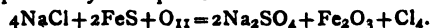
Dr. Schuster's letter shows that the point is not an unimportant one, and as I have lately made a few experiments which seem to confirm the assumption on which my explanation was based, I beg to solicit space for it in the *CHEMICAL NEWS*.

The theory I put forward is that the blue flame noticed in the instance of a coal fire (bituminous) on which salt has been thrown is possibly due simply to the presence of carbonic oxide (CO), produced by a series of reactions through which the common salt is converted into sulphide of sodium, as in the manufacture of crude carbonate of soda (black-ash); all the reactions being performed in one furnace instead of two, and almost simultaneously.

Leblanc's process consists in—(1) Converting common salt into sulphate of sodium. (2) The "salt cake" resulting is then mixed with coal and limestone, placed in a furnace, and heated strongly, during which part of the process a blue flame of carbonic oxide is observed to play upon the surface.

In the case we have under consideration the only difference is that the salt is converted into sulphate of sodium by the oxidation of the iron pyrites, from which no coal is free (and, in fact, it has been proposed to use such a process commercially, viz., by roasting salt with iron pyrites).

At this stage, then, the reaction going on in the fire will be expressed by the equation—



Simultaneously with this the carbon of the coal comes into play, reducing the sulphate to sulphide, with evolution of carbonic oxide—



Of course were any substance present answering to the limestone used in practice—as might happen in the ash—we should have the full conversion to "black-ash," with further evolution of carbonic oxide—



I need not say that carbonic oxide burns with a violet-blue flame, perfectly indistinguishable from that produced by throwing salt into a bituminous coal fire. This may be

proved at once by experimenting on a fire of *anthracite*, which itself usually only gives out the lambent blue flame of CO. The presence of salt makes no difference whatever in the colour of this flame, and it is difficult indeed to determine whether the salt is ignited at all. The difference in the two cases is just this:—A bituminous coal fire has usually a large bright or smoky flame: salt thrown on it causes its size and brightness to diminish by robbing it of the free carbon or hydrocarbon*—which gives it those qualities, and which is derived from the volatile matter—as in the reactions stated above, carbonic oxide resulting. But when anthracite is burned free carbon is absent, but carbonic oxide is formed; so that no alteration in colour is discernible. It is possible that the heat, instead of volatilising the sodium compound, and so giving the yellow flame, is entirely occupied in effecting the chemical changes.

With a spirit lamp or a Bunsen burner there is no free carbon, nor is there any iron pyrites to react on the salt, consequently the complicated processes just sketched out cannot go on, and the flame only exhibits the sodium colouration.

Dr. Schuster, in the note above mentioned, referred to a letter published by Dr. Gladstone in the *Phil. Mag.* (vol. xxiv., p. 477), giving a sketch of the similar behaviour of certain chlorides in imparting a blue colour to flames of various kinds. I find that in this paper the violet colour given by the chlorides of sodium, of potassium, and of barium to the flame of red-hot coals is noticed. Dr. Gladstone says, however, that "a doubt must rest on such observations made with a common coal fire, as it is quite conceivable that these chlorides may give up their chlorine to the alkalis or the earths of the ash."

It struck me that it would have some bearing on the matter to ascertain whether other salts of sodium exhibited the same property of tinging the flame blue, and I find that in these is no difference.

A little pure carbonate or sulphate of sodium thrown upon a common coal fire gives exactly the same blue colour as the chloride does; thrown on an anthracite fire they do not alter its bluish flame. Both give the intense yellow flame in the Bunsen burner.

It is clear, therefore, that the blue flame given by common salt cannot be ascribed to a property inherent to chlorides alone, and the solution I have given seems to be the most likely one. Of course the carbonate and the sulphate will give rise to much the same reactions as those stated above.

The following laboratory experiments were made with a view to check the above conclusions:—

- (1.) A small porcelain crucible was half filled with common salt, placed in a jacket, and exposed over a Bunsen burner. The flame appearing above the crucible was coloured intensely yellow.
- (2.) The same quantity of salt, mixed with powdered charcoal, was placed in the crucible. In this case the flame had hardly any yellow colour, and the edges occasionally appeared blue, the Bunsen flame being able to assert itself. The diminution of the yellow colouration was very marked.
- (3.) The crucible was filled with salt and powdered charcoal, together with a little sulphide of iron (the substance used for the preparation of sulphuretted hydrogen), and exposed over the Bunsen burner as before. The yellow colouration was almost entirely absent, while the blue flame became very distinct.

No difference could be observed in these experiments, whether the air was turned on or off.

When these mixtures were exposed in the naked flame on platinum wire they only gave the intense sodium colour. This is doubtless to be ascribed to the stronger heat volatilising same of the salt before it had time to pass

through the necessary changes. Moreover, the *slightest trace* of salt in such a mixture gave the yellow colour in the naked flame, while the mixtures used in the crucibles contained fully 15 per cent of salt, so that the supposition as to the effect of difference of temperature seems plausible.—I am, &c.,

EDWARD T. HARDMAN.

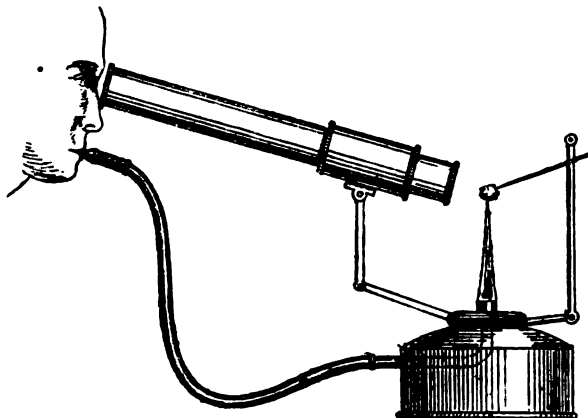
H.M. Geological Survey of Ireland.

Kilkenny, Aug. 25, 1876.

BLOWPIPE WITH SPECTROSCOPE FOR MINERALOGISTS.

To the Editor of the Chemical News.

SIR,—I enclose a sketch of an upright blowpipe with spectroscope adapted to its little lamp, the whole very portable. My object is discrimination in travelling between potass and soda and many other minerals. With hammer, chisel, lens, bottle of acid, magnetic penknife, and a little patience one can be far more independent of a laboratory than might be imagined. It is far more interesting to be able to determine a mineral on the spot, more especially as regards petrology, than to have to collect extensively and defer examination except with the blowpipe, which, as every one has to his aggravation experienced, leaves one



sadly in the lurch when one gets amongst impure alkalis and alkaline earths. As an instance I have detected both baryta and strontia in arragonite, which blowpipe *solus* failed to show me.—I am, &c.,

MARSHALL HALL.

Scientific Club, August 5, 1876.

CHEMICAL QUESTIONS.

To the Editor of the Chemical News.

SIR,—The manual of Prof. Tilden excels in the intelligent and thoughtful character of the exercises, but I must confess to have failed in the following case, and perhaps some better informed student may help me in the matter:—

J. (No. 35, p. 276.) "The analysis of barium diacetate gave the following results:—

0.2065 grm. gave 0.1297 grm. of BaSO₄.

0.1377 grm. gave 0.1307 of CO₂, and 0.0300 of H₂O.

What is the formula of the salt and corresponding acid?" I do not see how this data can furnish the amount of O.

I venture to add some other questions, which cannot well be solved without some approximative grasp of the generic nature of the reactions involved; hence it is that they have more than a mere numerical interest.

II. M. Grimaux has synthesised the following ureides. What are the types and genetic equations (without further data)?

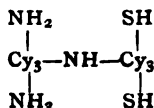
* Every cook knows that throwing salt on a fire "clears" renders it smokeless.



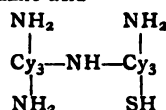
They have been easily resolved, and similarly with the following.

III. What are the types and genetic equations of the following acids?

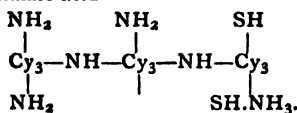
Di-thio-prussiamic acid—



Mono-thio-di-prussiamic acid—



Dithio-tri-prussiamic acid—



—I am, &c.,

S. E. P.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 5, July 31, 1876.

Fifth Note on Electric Transmissions through the Soil.—M. Th. du Moncel.—Not suitable for abstraction.

Globular Thunderbolts.—M. G. Planté.—The author gives an account of a violent storm at Paris on July 24, between 3.30 and 4 p.m., in which the lightning fell in a globular form upon the house No. 28 of the Rue des Tournelles, and on the corner of the theatre of the Boulevard Beaumarchais. The formation of globular thunderbolts results—(1) From the aggregation in a spherical form of ponderable matter and, in particular, of air and watery vapour, in consequence of the aspiration and the rarefaction which the electric flux determines in its passage; (2) of the condensation of positive electricity in this medium. The electricity is dissipated silently if the soil is strongly negative, otherwise there is an explosion.

Radiometers of Crookes Formed of Laminæ of a Metal and of Mica.—MM. Alvergnyat.—As for radiometers partly of metal and partly of mica the authors have not succeeded in rendering them insensible, and still less those of mica alone and blackened. Nevertheless they have a radiometer of plates of metal and of mica blackened, which, when a vacuum had been made in the ordinary manner, turned very readily on approaching a match to the case. On heating very strongly, and continuing to exhaust, it became much less sensitive; the radiation of more than twenty candles placed at 10 centimetres from the globe did not suffice to make it stir, and the full light of the sun was required to set it in motion. But this radiometer, so little sensitive to light, remained highly sensitive to obscure heat. The mere warmth of the hand sufficed to set it in rapid rotation in an inverse direction.

Dissociation of the Vapour of Calomel.—H. Debray.—At 440° calomel experiences incipient decomposition.

Action of Hydracids upon Tellurous Acid.—M. A. Ditte.—An examination of the behaviour of tellurous acid with hydrochloric acid. The author has succeeded in obtaining the compounds 2TeO_2 , 3HCl , and TeO_2HCl .

New Salts of Bismuth, and their Application in the Detection of Potassa.—M. A. Carnot.—Reserved for insertion in full.

Isomerism of the Rotatory Power in the Camphols.—M. J. de Montgolfier.—The camphols of different origin, natural or artificial, differ among themselves merely by their rotatory power, and we have not at present, in the preparation of this body, even by the same methods, obtained identical results. These various rotations cannot evidently indicate true isomerisms; they may be explained, on the contrary, by mixtures of an active with an inactive body. The author has arrived at the conclusion that borneol may be easily obtained of as high a rotatory power as may be desired up to a limit, which is about 37° for the ray D. This borneol at 37° is the true active body with a complete rotatory power. He has not yet succeeded in obtaining a borneol entirely inactive.

Cause of the Spontaneous Alteration of Anhydrous Hydrocyanic Acid, and on a New Case of the Total Transformation of this Acid.—M. J. de Girard.—It is known that anhydrous cyanic acid sometimes undergoes in a short time the azulmic decomposition, whilst in other cases it may be preserved for months without change. The cause of this difference is due to the chloride of calcium used in desiccation. If this is neutral the acid obtained will be pure, and may be preserved indefinitely; if it is alkaline, which is the case when it has been calcined in contact with the air, the hydrocyanic acid will soon undergo spontaneous decomposition. There is also another cause of the transformation of hydrocyanic acid, not connected with the presence of a trace of alkali, namely, heat. If the pure acid is heated for four to five hours in a sealed tube to 100° it soon turns brown, and finally congeals into a black compact mass. On opening the tubes there is no escape of gas. The acid heated to 100° with anhydrous ether or absolute alcohol experiences a modification which appears analogous.

Decomposition of Cyanide of Potassium, Cyanide of Zinc, and Formiate of Potassa in Carbonic Acid, Air, and Pure Hydrogen.—MM. L. Naudin and F. de Montholon.—Cyanide of potassium is decomposed in inert gases, and the decomposition is only limited by the alkalinity due to the potassa formed. In the case of carbonic acid there is no limit, because the alkali is saturated as it is produced. Cyanide of zinc is slowly decomposed by a rapid current of carbonic acid, and also, though more slightly, by air freed from carbonic acid. Cyanides of uranium and nickel show no trace of decomposition even in a prolonged current of carbonic acid.

Two New Sulphuretted Ureas.—MM. P. de Clermont and E. Wehrin.—The ureas in question are cresyl-sulphocarbamide, $\text{CS.NH}_2\text{NHC}_6\text{H}_7$, and naphthyl-sulphocarbamide, $\text{CSN}_2\text{NHC}_{10}\text{H}_7$.

Industrial Use of Vanadium in the Manufacture of Aniline-Black.—M. G. Witz.—After having verified the action of vanadium upon mixed solutions of chlorates and of muriate of aniline, I have found that in dyeing cotton-skeins black the oxidation is considerably hastened in proportion to the concentration of the dye-baths, and, inversely, it becomes the slower as the liquids are more dilute. Having perceived that the reaction begins, not abruptly, but in a manner almost insensible at first, becoming subsequently accelerated, and being completed in a time which varies in the direct ratio of the greater or less quantities of the metal, always very small, which are present, I have profited by these favourable circumstances to apply this mode of the formation of aniline-black to

colours thickened for printing. In certain series of trials I have determined the exceedingly reduced proportion of vanadium which must be employed in the colour to realise the oxidation of the aniline. I have worked very carefully, making impressions with the finger, avoiding all contact with copper or other metals, and with salts as pure as possible. I finally found that in printing one hundred-thousandth of the weight of the aniline salt may be employed. I have printed for some months aniline-blacks in considerable quantity, and have always found a rapidity of oxidation proportional to the amount of the metal employed. It is sufficient to take a quantity of vanadium corresponding to 1-100,000th or 1-200,000th of the weight of muriate of aniline to obtain in a few days, at the temperature of 25° C., a sufficient oxidation. About 1-30,000th may be taken for colours containing 80 grms. of muriate of aniline to the litre of mixed colour. In two or three days at 25° C., and 20° moisture, the colour is perfectly developed. The preparations of sulphuret of copper have been completely abandoned in favour of vanadium, which secures results more prompt and perfect, avoids the deposition of copper on the steel doctors and the corrosion of the engraved cylinders, and, a remarkable thing, the thickened colours may be preserved for several weeks without change. With all these advantages, vanadium only costs the eleventh part of what was formerly paid for copper. All the soluble compounds of vanadium may be used, as the contact with chloric acid brings them to the maximum degree of oxidation. The quantities of vanadium to be added to aniline-blacks vary, in general, inversely as the concentration—that is to say, the proportion of aniline which they contain, as well as the temperature and the length of time set apart for oxidation. The following are the advantages derived from the use of vanadium:—(1) Amelioration of the richness of the black, and the distinctness of the impression. (2) Suppression of the corrosion of the doctors and cylinders. (3) Facility of regulating the duration of the oxidation at will. (4) Long preservation of the thickened colour. (5) Simpler and more economic preparation.

Manufacture of Dynamite.—M. A. Sobrero.—The author has used the earth of Santa Fiora, in Tuscany, as a substitute for Kieselguhr.

Cellulosic Fermentation Produced by the Aid of Vegetable Organs, and Probable Utilisation of Sugar in Vegetation for the Formation of Cellulose.—M. Durin.—Not adapted for abstraction.

Microzymas of Sprouted Barley and of Sweet Almonds as Producers of Diastase and Synaptase, with reference to a Paper by MM. Pasteur and Joubert.—M. A. Bechamp.—The author defends his views against the paper of Pasteur and Joubert (*Comptes Rendus*, lxxiii., p. 5).

Correction in a Communication on Bread-Making in the United States, and on the Properties of the Hop as a Ferment.—M. Sacc.—M. Sacc states that the hop is not a ferment, but merely preserves the yeast from entering into the lactic fermentation.

Note on the Fermentation of Urine, with reference to a Communication by M. Pasteur.—M. H. C. Bastian.

Observations Relative to the Opinions ascribed by Dr. Bastian to Prof. Tyndall.—An extract from two letters from Prof. Tyndall to M. Dumas. (These papers are a contribution to the "burning question" of spontaneous generation.

Metallic Dust in the Atmosphere.—Dr. T. L. Phipson.—The author gives a few cases of the occurrence of metallic dust in the atmosphere in situations where it could not well be derived from artificial sources, and remarks that there certainly exist in the air a great number of substances which ordinary chemical analysis does not indicate.

Bulletin de la Societe Chimique de Paris,
No. 2, July 20, 1876.

Remarks on the Real Existence of a Matter formed of Isolated Atoms comparable to Material Points.—M. Berthelot.—With reference to the conclusion of MM. Kundt and Warburg (*Poggendorff's Annalen*, clvii., 356), that the molecule of mercurial gas behaves sensibly as a material point from the point of view of its mechanical and thermic properties, the hypothesis of a monatomic matter in an absolute sense has nothing in common, save the name, with the conceptions of chemists who reason merely on the ponderable ratios of the molecules which are combined or substituted, their atom being defined by its minimum proportionate value. It would require, in my opinion, proofs very different from the speed of sound in a vapour to be admitted. The very notion of an atom indivisible and yet extended and continuous, as well as that of an atom endowed with mass and yet reduced to a material point, seems contradictory in itself.

Thermic Formation of Ozone.—M. Berthelot.—Ozone is a body formed with absorption of heat; it disengages this excess of heat in its oxidations, which explains its superior activity to that of common oxygen. This excess of heat or of energy has been stored up under the influence of electricity; still a remarkable excess, because we have to do with the formation of a body more condensed than that which produces it.

Absorption of Free Pure Nitrogen by Organic Matters at Common Temperatures.—M. Berthelot.—Already noticed.

Reply to certain Critical Objections on Atomicity by M. J. A. le Bel.—M. E. Bourgoïn.—If we admit the successive saturation of the elements, as is generally thought in France, and as M. le Bel himself appears to admit, we render illusory all the atomic theory relating to atomicities, as M. Berthelot has judiciously observed. One of the fundamental principles of the atomic theory is that the volume represents the atom, but this principle is implicitly contradicted by experiment: to admit that the atoms of mercury and cadmium represent two volumes, whilst those of phosphorus and arsenic correspond to half a volume, is merely begging the question.

Nitrated Alizarin.—M. A. Rosenstiehl.—Reserved for insertion in full.

Detection of Magenta in Wines.—M. E. Jacquemin.—Already noticed.

Decomposition of Insoluble Carbonates by Sulphuretted Hydrogen.—MM. L. Naudin and F. de Montholon.—Already noticed.

No. 3, August 5, 1876.

Absorption of Free Hydrogen under the Influence of the Effluve.—M. Berthelot.—Hydrogen is absorbed by organic compounds under the influence of the effluve even more rapidly than nitrogen. This has been observed with benzin, terebenthen, acetylen, &c.

New Researches on the Pyrogenous Carbides and on the Composition of Coal-Gas.—M. Berthelot.—A lengthy paper, not suitable for abstraction.

Formation and Decomposition of Binary Compounds by the Electric Effluve.—M. Berthelot.—Ammonia is formed from a mixture of hydrogen and nitrogen. Protioxide of nitrogen is decomposed into free oxygen and nitrogen, and no new oxide of nitrogen is formed. With binioxide of nitrogen a portion of the nitrogen is set free, and protioxide of nitrogen is formed. Sulphuretted hydrogen is decomposed into hydrogen, polysulphide of hydrogen, and free sulphur. The behaviour of seleniuretted hydrogen is similar. Phosphoretted hydrogen is resolved into hydrogen and yellow subphosphuret. The fluorides of boron and silicon, chlorine, and gaseous bromine are not affected. Sulphurous acid is, to a small extent, converted into free oxygen and sulphur insoluble in the bi-

sulphide of carbon. Cyanogen is quickly converted into paracyanogen.

Pyrogenous Decomposition of Nitrate of Ammonia, and on the Volatility of Ammoniacal Salts.—M. Berthelot.—Not suitable for abstraction.

Reply to the Second Memoir of M. Bourgoïn.—M. J. A. Le Bel.—This discussion seems to be in danger of becoming personal.

Decomposition of Alkaline Bicarbonates; Dry and Moist, under the Influence of Heat and of a Vacuum.—M. A. Gautier.—Already noticed.

Alkaline Sulphocarbonates: Criticism on a Product having for its basis Sulphocarbonate of Potassium, and Proposed for the Destruction of the Phylloxera.—M. A. Mermet.—This paper points out the defects of a patent for mixing guano, gypsum, and sulphocarbonate of potassium, and using the resulting compound as a dressing for vines attacked by the phylloxera.

Decomposition of Cyanide of Potassium, Cyanide of Zinc, and Formiate of Potassa in Carbonic Acid, Air, and Pure Hydrogen.—MM. Naudin and Montholon.—Already noticed.

Two New Sulphuretted Ureas.—MM. Clermont and Wehrlin.—Already noticed.

Note on a Modification introduced into Sugar-Refining.—M. Daniel Klein.—A lengthy paper not suited for abstraction.

The Preparation, the Atomic Weight, and the Determination of Cerium free from Didymium.—M. H. Buhrig.—The atomic weight found is 94.1782. The author proposes to weigh cerium as ceroso-ceric oxide, Ce_2O_3 , the composition of which is perfectly constant; the sulphate, oxalate, and hydrate of cerium are transformed into ceroso-ceric oxide at a white-red heat. The author concludes his memoir by an account of some experiments on the influence of certain salts on the sensibility of the reaction of potassic sulphocyanide with ferric chloride. It was known that certain phosphates and fluorides destroy or lessen the intensity of the colouration, but according to the author many other compounds have the same effect, such as free sulphuric acid and the sulphates of Na, K, Mg, and Ce.

Determination of Lithium by means of the Spectroscope.—M. H. Ballmann.—If we dilute progressively a solution of chloride of lithium a point is reached when the ray $\text{Li}\alpha$ is no longer visible. According to the author's experiments this limit is fixed for each observer, though liable to individual variations. For the author's eye this limit is 1 m.g. chloride of lithium dissolved in 3345 c.c. If we gradually dilute with water a liquid containing lithic chloride up to the point when a drop evaporated on a platinum wire no longer shows the ray $\text{Li}\alpha$, the solution contains 1 m.g. LiCl in 33.45 c.c. of water, whence the original proportion may be easily calculated according to the quantity added.

Determination of Gold in Pyrites.—M. H. Schwarz.—The author melts 100 grms. pyrites with 46.6 grms. fine iron turnings under a layer of common salt. The monosulphide formed is powdered, and attacked with dilute sulphuric acid in a gas apparatus, the sulphuretted hydrogen being received in ammonia. The matter insoluble in acid is collected, washed, dried, and roasted. It is then mixed with borax and about 2 grms. granulated lead, and the mixture melted in a muffle until the lead collects in a single globule floating in ferruginous scoriae. This globule is detached, and submitted to cupellation.

Precipitation of Zinc by Sulphuretted Hydrogen in Presence of Bisulphate of Potassium.—M. G. Sulhorst.—Sulphuretted hydrogen partially precipitates zinc from a solution of sulphate of zinc containing bisulphate of potassium, but if the proportion of the latter salt exceeds a certain limit the liquid is no longer rendered turbid. Thus, a solution of 2 grms. sulphate of zinc and 1 grm.

bisulphate of potassium gives with sulphuretted hydrogen a precipitate of zinc sulphide containing 19 per cent of the total zinc present in the liquid. If the quantity of bisulphate of potassium is raised to 2 grms. there is no precipitation.—*Zeitschrift für Analytische Chemie.*

Determination of Theine in Tea.—M. H. Schwarz.—Exhaust with boiling acidulated water, neutralise with lime, evaporate to dryness, and exhaust residue with ether. The extract is evaporated to dryness, and the residue weighed as theine.

Determination of Anthracen in Coal-Tar.—M. C. Nicol.—The tar (10 to 20 grms.) is distilled in a small glass retort, luted, and the vapours are directed into a U-tube serving as a receiver, and heated to 200° in a bath of paraffin. The volatile products boiling below 200° are not condensed, whilst anthracen and hydrocarbides, having high boiling-points, collect in the U-tube. A small quantity of the products of distillation remains in the anterior part of the neck of the retort, which is therefore cut off, pounded, and the fragments added to the distillate. The distillate is then dissolved in glacial acetic acid by the aid of heat, the acid being added in small portions, and it is finally transformed into anthraquinon by means of Luck's process. The temperature should be very high towards the end of the distillation.—*Zeitschrift für Analytische Chemie.*

Les Mondes, Revue Hebdomadaire des Sciences,
No. 15, August 10, 1876.

M. Rieffel, of Grandjouan, finds that petroleum is the most satisfactory insecticide yet known.

M. Devergie calls attention to the supposed power of the salts of copper for the prevention of cholera.

MISCELLANEOUS.

Mineralogical Society of Great Britain and Ireland—A general meeting of the members of the Mineralogical Society will be held at Glasgow, on Wednesday next, September 6, 1876, after the meeting of the General Committee of the British Association. The exact time and place will be posted up in the British Association Reception Rooms. The chair will be taken by Professor M. Forster Heddle, M.D., F.R.G.S.

University of London.—Examinations for Honours.—*First B.A. and First B.Sc., conjointly.*—Mathematics and Mechanical Philosophy:—1st class. J. E. Aloysius Steggall, First B.A. (Exhibition), Trinity College, Cambridge; Henry Robert Olley, First B.A., Owens College. 2nd class. John Arthur Owen, First B.Sc., private study; Arthur Black, First B.Sc., private study. 3rd class. Walter Plumb Root, First B.A., private study. *First B.Sc. and Preliminary M.B., conjointly.*—Chemistry: 1st class. Ernest H. Cook, First B.Sc., (Exhibition), Royal College of Science, Dublin; Robert Maguire, Prel. Sci., Owens College. 2nd class. William Henry Higgin, First B.Sc., Owens College; Thomas Gough, First B.Sc., private study; James Hugh Paul, First B.Sc. and Prel. Sci., private study; Beaven Neave Rake, Prel. Sci., Guy's Hospital. 3rd class. William Freame, First B.Sc. and Prel. Sci., Royal College of Science, Dublin; Henry Thomas Groom, Prel. Sci., St. Bartholomew's Hospital; Francis Bowe, Prel. Sci., St. Bartholomew's Hospital; James Norie, Prel. Sci., University College. Zoology: 1st class. David Alexander King, Prel. Sci., St. Bartholomew's Hospital. 2nd class. Arthur George Dawson, Prel. Sci., Owens College; Charles Pardey Lukis, Prel. Sci., St. Bartholomew's Hospital; Mark Feetham Sayer, Prel. Sci., University College; William Evans Hoyle, First B.Sc. and Prel. Sci., Owens College and Christ Church, Oxford; Wayland Charles Chaffey, Prel. Sci.

St. Bartholomew's Hospital; Denis McDonnell, Prel. Sci., King's College. 3rd class. Robert Henry Scanes Spicer, Prel. Sci., private study; Robert Maguire, Prel. Sci., Owens College; Henry Thomas Groom, Prel. Sci., St. Bartholomew's Hospital. Experimental Physics: 1st class. H. F. B.A., Morley, First B.Sc. (Arnott Exhibition and Medal), University College. 2nd class. Thomas Bolton, First B.Sc., University College. 3rd class. Julian Stephens, First B.Sc. and Prel. Sci., University College and private study. Botany: 1st class. Joseph Tregelles Fox, Prel. Sci., London Hospital. 2nd class. Anundrao Atmaram, First B.Sc. and Prel. Sci., University College; Robert Henry Scanes Spicer, Prel. Sci., private study; John Mitford Atkinson, Prel. Sci., London Hospital; Andrew William Dallmeyer, First B.Sc. and Prel. Sci., University College; Richard Sisley, Prel. Sci., St. George's Hospital. 3rd class. Charles Pardey Lukis, Prel. Sci., St. Bartholomew's Hospital; Henry Thomas Groom, Prel. Sci., St. Bartholomew's Hospital.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphates of soda and potash, and in calcining carbonates of soda and potash. W. Jones and J. Walsh, Middlesbrough-on-Tees, York. May 21, 1875.—No. 1864. According to this Provisional Specification, the charge of chlorides, &c., is put into a flat-bottomed circular metal pan, which forms the bed of a furnace, and on this pan the sulphates are decomposed and calcined until they are finished in one operation. Above the bed are blades for stirring the charge.

Improvements in the treatment of wool, either in the raw or in a manufactured condition. J. Behrens, Bradford, York. (A communication from H. Caro, Mannheim, Germany.) May 21, 1875.—No. 1868. This invention consists in submitting wool, either in the raw or in an unmanufactured or manufactured condition, to the action of chlorine until the shrinking, curling, or felting properties possessed by wool in its natural condition shall have been destroyed or modified.

Improvements in the means or apparatus employed in melting, refining, converting, and puddling iron. W. Middleton, Leeds, York. May 22, 1875.—No. 1881. There is a retort between puddling and heating furnace for receiving cast metal preparatory to its being melted. For refining, a blast is introduced into the retort.

Improved processes for the manufacture of ammoniacal salts, and more particularly the sulphate of ammonia. A. M. Clark, Chancery Lane, Middlesex. (A communication from T. Moerman-Laubuhr, Antwerp, Belgium.) May 22, 1875.—No. 1888. The invention consists in the manufacture of cyanides and alkaline cyanates by means of the nitrogen of the air, and afterwards decomposing their cyanogen in a separate operation, in order to convert the nitrogen into ammonia, which then needs only to be fixed by means of acids and crystallised.

Improvements in the means of and apparatus for the purification of gas. C. Woodall, Vauxhall, and T. Willis, Brixton, Surrey. May 24, 1875.—No. 1891. This invention relates to a method of and apparatus for the better purification of gas from ammonia, carbonic acid, sulphuretted hydrogen, bisulphide of carbon, and their compounds, being accomplished by the injection into certain washers or scrubbers or system of washers or scrubbers, either of the ordinary or some special form of a combined jet or jets of steam and water, or of steam and ammoniacal liquor purified or not, or of sulphide of ammonium specially prepared, or of some other liquid purifying agent, calculated to remove any or all of the above-mentioned compounds. The use of water, purified ammoniacal liquor, or sulphide of ammonium is not new; but the application of these liquids through the intervention of a compound jet or jets, consisting of one tube inserted within another, the outer one being used for the delivery of the liquid and the inner one for the injection of the steam, whereby the gas is subjected to a more effectual washing, is new; as is also the use of crude ammoniacal liquor by means of the said jet or jets for the removal of sulphur compounds from gas which has been previously freed from carbonic acid.

Improvements in the purification of gas, and in the preparation of materials to be used in the said purification. F. C. Hills, Deptford, Kent. May 24, 1875.—No. 1895. This invention consists in separating the sulphuretted hydrogen gas from the carbonic acid gas driven off from gas-liquor while it is being purified by the processes protected by Letters Patent, Nos. 1369, 1868, and 934, 1874, and utilising such sulphuretted hydrogen gas to form sulphide of ammonium, which may be used for purifying gas from bisulphide of carbon. The sulphuretted hydrogen may also be used to form other sulphides, some of which (e.g., sulphide of calcium) are also useful for purifying gas from bisulphide of carbon. Sulphide of ammonium may also be made by passing the sulphuretted hydrogen and carbonic acid gases driven off from the gas-liquor as aforesaid through scrubbers down which gas-liquor is caused to pass.

Improvements in the manufacture of chlorine. H. Deacon, Appleton House, Widnes, Lancaster. May 25, 1875.—No. 1909. The essential feature of this invention consists in the employment for the production

of chlorine by what is known as Deacon's process of a mixture of compounds of copper in conjunction with salts or compounds of magnesia, the same being employed either in conjunction with porous substances impregnated with the same, or with magnesite, or with other solid compounds of magnesia, or with compounds of magnesia, or with compounds containing magnesia. Or instead of employing salts or compounds of magnesia in conjunction with salts or compounds of copper, as before referred to, salts of barium, or other elements of like chemical action, may be substituted.

Improvements in the treatment of salt or crude chloride of sodium preparatory to chemical processes, and in apparatus employed in such treatment. R. Milburn and H. Jackson, Pomeroy Street, New Cross Road, Surrey. May 26, 1875.—No. 1917. The inventors form balls of salt by means of a moulding machine. These balls are then dried in a stove on a travelling apron formed of hinged plates, which hang down when returning to the feeding end.

ST. HELENS, LANCASHIRE.

TO CHEMICAL MANUFACTURERS and CAPITALISTS. VALUABLE CHEMICAL WORKS AT ST. HELENS.

To be Sold by Auction, by Messrs. J. B. and B. Leach, at the Fleece Hotel, St. Helens, on Tuesday, the 12th September, 1876, at 2 o'clock in the afternoon, subject to conditions then to be produced.

All that new and complete Chemical Manufactory known as the Merton Bank Alkali Works situate at Parr, St. Helens. The works are now in thorough and complete working order and condition, and comprise Back Ash and Caustic Sheds, Office Laboratory, Stable, Brick Chimney, Lime House, &c. The Plant includes three Black Ash Furnaces with pans over, six Black Ash Vats, eight Caustic Pots, two Liquor Tanks, two Causticifiers, Filters, Tanks, Steam Boiler 26 feet long, 8 feet diameter, 6 tons Weighing Machine, Fire-proof Safe, Office and Laboratory Fittings and Furniture.

The Premises adjoin the St. Helens and Widnes Canal, by which there is direct communication with the River Mersey, and there is a very considerable space for deposit of waste on the land, and an excellent supply of water on the premises.

The tenure is leasehold for two respective terms of 999 years from 1st November, 1871, and 1st August, 1874, subject to the respective rents of £35 14s. and £75. Total contents 17,066 superficial square yards of land or thereabouts.

The Mines are reserved to former owners with certain rights for getting the same.

The Premises may be inspected on application to the Watchman. Plans and Particulars may be obtained from the Auctioneers at their Offices, Manor Chambers, St. Helens, and 53, North John Street, Liverpool, Mr. J. M. Wilson, Surveyor, St. Helens, or from THOMAS BREWIS, Solicitor, St. Helens.

St. Helens, August, 1876.

**Mawson and Swan are now able to supply
CROOKES'S RADIOMETER at 25s.**

11 and 15, Mosley Street, Newcastle-on-Tyne.

BUNGE'S IMPROVED BALANCE

For Chemical Analysis and Exact Weighing
generally. The most sensitive, and in every respect most perfect balance. Agents for England: MAWSON and SWAN, Newcastle-on-Tyne.

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THE CHEMICAL NEWS.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

GLASGOW MEETING, SEPTEMBER 6, 1876.

INAUGURAL ADDRESS OF THE PRESIDENT,

THOMAS ANDREWS, M.D., LL.D., F.R.S.,
HON.F.R.S.E., M.R.I.A., &c.

Six and thirty years have passed over since the British Association for the Advancement of Science held its tenth meeting in this ancient city, and twenty-one years have elapsed since it last assembled here. The representatives of two great Scottish families presided on these occasions; and those who had the advantage of hearing the address of the Duke of Argyll in 1855 will recall the gratification they enjoyed while listening to the thoughtful sentiments which reflected a mind of rare cultivation and varied acquirements. On the present occasion I have undertaken, not without anxiety, the duty of filling an office at first accepted by one whom Scotland and the Association would alike have rejoiced to see in this Chair, not only as a tribute to his own scientific services, but also as recognising in him the worthy representative of that long line of able men who have upheld the pre-eminent position attained by the Scottish schools of medicine in the middle of the last century, when the mantle of Boerhaave fell upon Monro and Cullen.

The task of addressing this Association, always a difficult one, is not rendered easier when the meeting is held in a place which presents the rare combination of being at once an ancient seat of learning and a great centre of modern industry. Time will not permit me to refer to the distinguished men who in early days have left here their mark behind them; and I regret it the more, as there is a growing tendency to exaggerate the value of later discoveries, and to underrate the achievements of those who have lived before us. Confining our attention to a period reaching back to little more than a century, it appears that during that time three new sciences arose, at least as far as any science can be said to have a distinct origin, in this city of Glasgow—Experimental Chemistry, Political Economy, and Mechanical Engineering. It is now conceded that Black laid the foundation of modern chemistry; and no one has ever disputed the claims of Adam Smith and of Watt to having not only founded, but largely built up, the two great branches of knowledge with which their names will always be inseparably connected. It was here that Dr. Thomas Thomson established the first school of Practical Chemistry in Great Britain, and that Sir W. Hooker gave to the chair of Botany a European celebrity; it was here that Graham discovered the law of gaseous diffusion and the properties of polybasic acids; it was here that Stenhouse and Anderson, Rankine and J. Thomson made some of their finest discoveries; and it was here that Sir William Thomson conducted his physico-mathematical investigations, and invented those exquisite instruments, valuable alike for ocean telegraphy and for scientific use, which are among the finest trophies of recent science. Nor must the names of Tennant, Mackintosh, Neilson, Walter Crum, Young, and Napier be omitted, who, with many others in this place, have made large and valuable additions to practical science.

The safe return of the "Challenger," after an absence

of three and a half years, is a subject of general congratulation. Our knowledge of the varied forms of animal life, and of the remains of animal life, which occur, it is now known, over large tracts of the bed of the ocean, is chiefly derived from the observations made in the "Challenger" and in the previous deep-sea expeditions which were organised by Sir Wyville Thomson and Dr. Carpenter. The physical observations, and especially those on the temperature of the ocean, which were systematically conducted throughout the whole voyage of the "Challenger," have already supplied valuable data for the resolution of the great question of ocean-currents. Upon this question, which has been discussed with singular ability, but under different aspects, by Dr. Carpenter and Mr. Croll, I cannot attempt here to enter; nor will I venture to forestall, by any crude analysis of my own, the narrative which Sir Wyville Thomson has kindly undertaken to give of his own achievements and of those of his staff during their long scientific cruise.

Another expedition, which has more than fulfilled the expectations of the public, is Lieutenant Cameron's remarkable journey across the continent of Africa. It is by such enterprises, happily conceived and ably executed, that we may hope at no distant day to see the Arab slave dealer replaced by the legitimate trader, and the depressed populations of Africa gradually brought within the pale of civilised life.

From the North Polar Expedition no intelligence has been received; nor can we expect for some time to hear whether it has succeeded in the crowning object of Arctic enterprise. In the opinion of many, the results, scientific or other, to be gained by a full survey of the Arctic regions can never be of such value as to justify the risk and cost which must be incurred. But it is not by cold calculations of this kind that great discoveries are made or great enterprises achieved. There is an inward and irrepressible impulse—in individuals called a spirit of adventure, in nations a spirit of enterprise—which impels mankind forward to explore every part of the world we inhabit, however inhospitable or difficult of access; and if the country claiming the foremost place among maritime nations shrink from an undertaking because it is perilous, other countries will not be slow to seize the post of honour. If it be possible for man to reach the poles of the earth, whether north or south, the feat must sooner or later be accomplished; and the country of the successful adventurers will be thereby raised in the scale of nations.

The passage of Venus over the sun's disk is an event which cannot be passed over without notice, although many of the circumstances connected with it have already become historical. It was to observe this rare astronomical phenomenon, on the occasion of its former occurrence in 1769, that Captain Cook's memorable voyage to the Pacific was undertaken, in the course of which he explored the coast of New South Wales, and added that great country to the possessions of the British Crown.

As the transit of Venus gives the most exact method of calculating the distance of the earth from the sun, extensive preparations were made on the last occasion for observing it at selected stations—from Siberia in northern, to Kerguelen's Land in southern latitudes. The great maritime powers vied with each other to turn the opportunity to the best account; and Lord Lindsay had the spirit to equip, at his own expense, the most complete expedition which left the shores of this country. Some of the most valuable stations in southern latitudes were desert islands, rarely free from mist or tempest, and without harbours or shelter of any kind. The landing of the instruments was in many cases attended with great difficulty and even personal risk. Photography lent its aid to record automatically the progress of the transit; and M. Janssen contrived a revolving plate, by means of which from fifty to sixty images of the edge of the sun could be taken at short intervals during the critical periods of the phenomenon.

The observations of M. Janssen at Nagasaki, in Japan,

were of special interest. Looking through a violet-blue glass he saw Venus, two or three minutes before the transit began, having the appearance of a pale round spot near the edge of the sun. Immediately after contact the segment of the planet's disk, as seen on the face of the sun, formed, with what remained of this spot, a complete circle. The pale spot when first seen was, in short, a partial eclipse of the solar corona, which was thus proved beyond dispute to be a luminous atmosphere surrounding the sun. Indications were at the same time obtained of the existence of an atmosphere around Venus.

The mean distance of the earth from the sun was long supposed to have been fixed within a very small limit of error at about 95,000,000 miles. The accuracy of this number had already been called in question on theoretical grounds by Hansen and Leverrier, when Foucault, in 1862, decided the question by an experiment of extraordinary delicacy. Taking advantage of the revolving-mirror, with which Wheatstone had some time before enriched the physical sciences, Foucault succeeded in measuring the absolute velocity of light in space by experiments on a beam of light, reflected backwards and forwards, within a tube little more than thirteen feet in length. Combining the result thus obtained with what is called by astronomers the constant of aberration, Foucault calculated the distance of the earth from the sun, and found it to be one-thirtieth part, or about 3,000,000 miles, less than the commonly received number. This conclusion has lately been confirmed by M. Cornu, from a new determination he has made of the velocity of light according to the method of Fizeau; and in complete accordance with these results are the investigations of Leverrier, founded on a comparison with theory of the observed motions of the sun and of the planets Venus and Mars. It remains to be seen whether the recent observations of the transit of Venus, when reduced, will be sufficiently concordant to fix with even greater precision the true distance of the earth from the sun.

In this brief reference to one of the finest results of modern science, I have mentioned a great name whose loss England has recently had to deplore, and in connection with it the name of an illustrious physicist whose premature death deprived France, a few years ago, of one of her brightest ornaments—Wheatstone and Foucault, ever to be remembered for their marvellous power of eliciting, like Galileo and Newton, from familiar phenomena, the highest truths of nature!

The discovery of Huggins that some of the fixed stars are moving towards and others receding from our system, has been fully confirmed by a careful series of observations lately made by Mr. Christie in the Observatory of Greenwich. Mr. Huggins has not been able to discover any indications of a proper motion in the nebulae; but this may arise from the motion of translation being less than the method would discover. Few achievements in the history of science are more wonderful than the measurement of the proper motions of the fixed stars, from observing the relative position of two delicate lines of light in the field of the telescope.

The observation of the American astronomer Young, that bright lines, corresponding to the ordinary lines of Fraunhofer reversed, may be seen in the lower strata of the solar atmosphere for a few moments during a total eclipse, has been confirmed by Mr. Stone, on the occasion of the total eclipse of the sun which occurred some time ago in South Africa. In the outer corona, or higher regions of the sun's atmosphere, a single green line only was seen, the same which had been already described by Young.

I can here refer only in general terms to the observations of Roscoe and Schuster on the absorption bands of potassium and sodium, and to the investigations of Lockyer on the absorptive powers of metallic and metalloidal vapours at different temperatures. From the vapour of calcium the latter has obtained two wholly distinct spectra, one belonging to a low, and the other to

a high temperature. Mr. Lockyer is also engaged on a new and greatly extended map of the solar spectrum.

Spectrum analysis has lately led to the discovery of a new metal—gallium—the fifth whose presence has been first indicated by that powerful agent. This discovery is due to M. Lecoq de Boisbaudran, already favourably known by a work on the application of the spectroscopy to chemical analysis.

Our knowledge of *aérolites* has of late years been greatly increased; and I cannot occupy a few moments of your time more usefully than by briefly referring to the subject. So recently as 1860 the most remarkable meteoric fall on record, not even excepting that of L'Aigle, occurred near the village of New Concord, in Ohio. On a day when no thunder-clouds were visible, loud sounds were heard resembling claps of thunder, followed by a large fall of meteoric stones, some of which were distinctly seen to strike the earth. One stone, above 50 lbs. in weight, buried itself to the depth of two feet in the ground, and when dug out was found to be still warm. In 1872, another remarkable meteorite, at first seen as a brilliant star with a luminous train, burst near Orvinio, in Italy, and six fragments of it were afterwards collected.

Isolated masses of metallic iron, or rather of an alloy of iron and nickel, similar in composition and properties to the iron usually diffused in meteoric stones, have been found here and there on the surface of the earth, some of large size, as one described by Pallas, which weighed about two-thirds of a ton. Of the meteoric origin of these masses of iron there is little room for doubt, although no record exists of their fall. Sir Edward Sabine, whose life has been devoted with rare fidelity to the pursuit of science, and to whose untiring efforts this Association largely owes the position it now occupies, was the pioneer of the newer discoveries in meteoric science. Eight and fifty years ago he visited, with Captain Ross, the northern shores of Baffin's Bay, and made the interesting discovery that the knife-blades used by the Esquimaux in the vicinity of the Arctic highlands were formed of meteoric iron. This observation was afterwards fully confirmed; and scattered blocks of meteoric iron have been found from time to time around Baffin's Bay. But it was not till 1870 that the meteoric treasures of Baffin's Bay were truly discovered. In that year Nordenskiöld found, at a part of the shore difficult of approach even in moderate weather, enormous blocks of meteoric iron, the largest weighing nearly 20 tons, imbedded in a ridge of basaltic rock. The interest of this observation is greatly enhanced by the circumstance that these masses of meteoric iron, like the basalt with which they are associated, do not belong to the present geological epoch, but must have fallen long before the actual arrangement of land and sea existed—during, in short, the middle Tertiary, or Miocene period of Lyell. The meteoric origin of these iron masses from Ovifak has been called in question by Lawrence Smith; and it is no doubt possible that they may have been raised by upheaval from the interior of the earth. I have indeed myself shown by a magneto-chemical process that metallic iron, in particles so fine that they have never yet been actually seen, is everywhere diffused through the Miocene basalt of Slieve Mish in Antrim, and may likewise be discovered by careful search in almost all igneous and in many metamorphic rocks. These observations have since been verified by Reuss in the case of the Bohemian basalts. But, as regards the native iron of Ovifak, the weight of evidence appears to be in favour of the conclusion, at which M. Daubrée, after a careful discussion of the subject, has arrived—that it is really of meteoric origin. This Ovifak iron is also remarkable for containing a considerable amount of carbon, partly combined with the iron, partly diffused through the metallic mass in a form resembling coke. In connection with this subject, I must refer to the able and exhaustive memoirs of Maskelyne on the Busti and other *aérolites*, to the discovery of vanadium by R. Apjohn in the meteoric iron, to the interesting observa-

tions of Sorby, and to the researches of Daubrée, Wöhler, Lawrence Smith, Tschermak, and others.

The important services which the Kew Observatory has rendered to meteorology and to solar physics have been fully recognised; and Mr. Gassiot has had the gratification of witnessing the final success of his long and noble efforts to place this observatory upon a permanent footing. A physical observatory for somewhat similar objects, but on a larger scale, is in course of erection, under the guidance of M. Janssen, at Fontenay, in France, and others are springing up or already exist in Germany and Italy. It is earnestly to be hoped that this country will not lag behind in providing physical observatories on a scale worthy of the nation and commensurate with the importance of the object. On this question I cannot do better than refer to the high authority of Dr. Balfour Stewart, and to the views he expressed in his able address last year to the Physical Section.

Weather telegraphy, or the reporting by telegraph the state of the weather at selected stations to a central office, so that notice of the probable approach of storms may be given to the seaports, has become in this country an organised system; and considering the little progress meteorology has made as a science, the results may be considered to be on the whole satisfactory. Of the warnings issued of late years, four out of five were justified by the occurrence of gales or strong winds. Few storms occurred for which no warnings had been given; but unfortunately among these were some of the heaviest gales of the period. The stations from which daily reports are sent to the meteorological office in London embrace the whole coast of Western Europe, including the Shetland Isles. It appears that atmospheric disturbances seldom cross the Atlantic without being greatly altered in character, and that the origin of most of our storms lies eastward of the longitude of Newfoundland.

As regards the velocity of the wind, the cup-anemometer of Dr. Robinson has fully realised the expectations of its discoverer; and the venerable astronomer of Armagh has been engaged during the past summer, with all the ardour of youth, in a course of laborious experiments to determine the constants of his instrument. From seven years' observations at the Observatory of Armagh he has found that the mean velocity of the wind is greatest in the S.S.W. octant and least in the opposite one, and that the amount of wind attains a maximum in January, after which it steadily decreases, with one slight exception, till July, augmenting again till the end of the year.

Passing to the subject of electricity, it is with pleasure that I have to announce the failure of a recent attempt to deprive Oerstedt of his great discovery. It is gratifying thus to find high reputations vindicated, and names which all men love to honour transmitted with undiminished lustre to posterity. At a former meeting of this Association, remarkable for an unusual attendance of distinguished foreigners, the central figure was Oerstedt. On that occasion Sir John Herschel, in glowing language, compared Oerstedt's discovery to the blessed dew of heaven which only the master-mind could draw down, but which it was for others to turn to account and use for the fertilisation of the earth. To Franklin, Volta, Coulomb, Oerstedt, Ampère, Faraday, Seebeck, and Ohm, are due the fundamental discoveries of modern electricity—a science whose applications in Davy's hands led to grander results than alchemist ever dreamed of, and in the hands of others (among whom Wheatstone, Morse, and Thomson occupy the foremost place) to the marvels of the electric telegraph. When we proceed from the actual phenomena of electricity to the molecular conditions upon which those phenomena depend, we are confronted with questions as recondite as any with which the physicist has had to deal, but towards the solution of which the researches of Faraday have contributed the most precious materials. The theory of electrical and magnetic action occupied formerly the powerful minds of Poisson, Green, and Gauss; and among the living it will surely not be invidious to cite the

names of Weber, Helmholtz, Thomson, and Clerk Maxwell. The work of the latter on electricity is an original essay worthy in every way of the great reputation and of the clear and far seeing intellect of its author.

Among recent investigations I must refer to Prof. Tait's discovery of consecutive neutral points in certain thermo-electric junctions, for which he was lately awarded the Keith prize. This discovery has been the result of an elaborate investigation of the properties of thermo-electric currents, and is specially interesting in reference to the theory of dynamical electricity. Nor can I omit to mention the very interesting and original experiments of Dr. Kerr on the dielectric state, from which it appears that when electricity of high tension is passed through dielectrics, a change of molecular arrangement occurs, slowly in the case of solids, quickly in the case of liquids, and that the lines of electric force are in some cases lines of compression, in other cases lines of extension.

Of the many discoveries in physical science due to Sir William Grove, the earliest and not the least important is the battery which bears his name, and is to this day the most powerful of all voltaic arrangements; but with a Grove's battery of 50 or even 100 cells in vigorous action, the spark will not pass through an appreciable distance of cold air. By using a very large number of cells, carefully insulated and charged with water. Mr. Gassiot succeeded in obtaining a short spark through air; and lately De la Rue and Müller have constructed a large chloride of silver battery giving freely sparks through cold air, which, when a column of pure water is interposed in the circuit, accurately resemble those of the common electrical machine. The length of the spark increasing nearly as the square of the number of cells, it has been calculated that with 100,000 elements of this battery the discharge should take place through a distance of no less than 8 feet in air.

In the solar beam we have an agent of surpassing power, the investigation of whose properties by Newton forms an epoch in the history of experimental science scarcely less important than the discovery of the law of gravitation in the history of physical astronomy. Three actions characterise the solar beam, or, indeed, more or less that of any luminous body—the heating, the physiological, and the chemical. In the ordinary solar beam we can modify the relative amount of these actions by passing it through different media, and we can thus have luminous rays with little heating or little chemical action. In the case of the moon's rays it required the highest skill on the part of Lord Rosse, even with all the resources of the Observatory of Parsonstown, to investigate their heating properties, and to show that the surface of our satellite facing the earth passes, during every lunation, through a greater range of temperature than the difference between the freezing- and boiling-points of water.

But if, instead of taking an ordinary ray of light, we analyse it as Newton did by the prism, and isolate a very fine line of the spectrum (theoretically a line of infinite tenuity), that is to say, if we take a ray of definite refrangibility, it will be found impossible, by screens or otherwise, to alter its properties. It was his clear perception of the truth of this principle that led Stokes to his great discovery of the cause of epipollic dispersion, in which he showed that many bodies had the power of absorbing dark rays of high refrangibility and of emitting them as luminous rays of lower refrangibility,—of absorbing, in short, darkness, and of emitting it as light. It is not, indeed, an easy matter in all cases to say whether a given effect is due to the action of heat or light; and the question which of these forces is the efficient agent in causing the motion of the tiny disks in Crookes's radiometer has given rise to a good deal of discussion. The answer to this question involves the same principles as those by which the image traced on the daguerreotype plate, or the decomposition of carbonic acid by the leaves of plants, is referred to the action of light and not of heat; and applying these principles to the experiments

made with the radiometer, the weight of evidence appears to be in favour of the view that the repulsion of the blackened surfaces of the disks is due to a thermal reaction occurring in a highly rarefied medium. I have myself had the pleasure of witnessing many of Mr. Crookes's experiments, and I cannot sufficiently express my admiration of the care and skill with which he has pursued this investigation. The remarkable repulsions he has observed in the most perfect vacua hitherto attained are interesting, not only as having led to the construction of a beautiful instrument, but as being likely, when the subject is fully investigated, to give valuable data for the theory of molecular actions.

A singular property of light, discovered a short time ago by Mr. Willoughby Smith, is its power of diminishing the electrical resistance of the element selenium. This property has been ascertained to belong chiefly to the luminous rays on the red side of the spectrum, being nearly absent in the violet or more refrangible rays and also in heat-rays of low refrangibility. The recent experiments of Prof. W. G. Adams have fully established the accuracy of the remarkable observation, first made by Lord Rosse, that the action appeared to vary inversely as the simple distance of the illuminating source.

Switzerland sent, some years ago, as its representative to this country the celebrated De la Rive, whose scientific life formed lately the subject of an eloquent *éloge* from the pen of M. Dumas. On this occasion we have to welcome, in General Menabrea, a distinguished representative both of the kingdom of Italy and of Italian science. His great work on the determination of the pressures and tensions in an elastic system is of too abstruse a character to be discussed in this address; but the principle it contains may be briefly stated in the following words:—"When any elastic system places itself in equilibrium under the action of external forces, the work developed by the internal forces is a minimum." General Menabrea has, however, other and special claims upon us here, as the friend to whom Babbage entrusted the task of making known to the world the principles of his analytical machine—a gigantic conception, the effort to realise which it is known was one of the chief objects of Babbage's later life. The latest development of this conception is to be found in the mechanical integrator of Prof. J. Thomson, in which motion is transmitted, according to a new kinematic principle, from a disk or cone to a cylinder through the intervention of a loose ball, and in Sir W. Thomson's machine for the mechanical integration of differential equations of the second order. In the exquisite tidal machine of the latter we have an instrument by means of which the height of the tide at a given port can be accurately predicted for all times of the day and night.

The attraction-meter of Siemens is an instrument of great delicacy for measuring horizontal attractions, which it is proposed to use for recording the attractive influences of the sun and moon, upon which the tides depend. The bathometer of the same able physicist is another remarkable instrument, in which the constant force of a spring is opposed to the variable pressure of a column of mercury. By an easy observation of the bathometer on ship-board, the depth of the sea may be approximately ascertained without the use of a sounding-line.

The Loan Exhibition of Apparatus at Kensington has been a complete success, and cannot fail to be useful, both in extending a knowledge of scientific subjects and in promoting scientific research throughout the country. Unique in character, but most interesting and instructive, this exhibition will, it is to be hoped, be the precursor of a permanent museum of scientific objects, which, like the present exhibition, shall be a record of old as well as a representation of new inventions.

It is often difficult to draw a distinct line of separation between the physical and chemical sciences; and it is perhaps doubtful whether the division is not really an artificial one. The chemist cannot, indeed, make any large

advance without having to deal with physical principles; and it is to Boyle, Dalton, Gay-Lussac, and Graham that we owe the discovery of the mechanical laws which govern the properties of gases and vapours. Some of these laws have of late been made the subject of searching inquiry, which has fully confirmed their accuracy, when the body under examination approaches to what has not inaptly been designated the ideal gaseous state. But when gases are examined under varied conditions of pressure and temperature, it is found that these laws are only particular cases of more general laws, and that the laws of the gaseous state, as it exists in nature, although they may be enunciated in a precise and definite form, are very different from the simple expressions which apply to the ideal condition. The new laws become in their turn inapplicable when from the gaseous state proper we pass to those intermediate conditions which, it has been shown, link with unbroken continuity the gaseous and liquid states. As we approach the liquid state, or even when we reach it, the problem becomes more complicated; but its solution even in these cases will, it may confidently be expected, yield to the powerful means of investigation we now possess.

Among the more important researches made of late in physical chemistry, I may mention those of F. Weber on the specific heat of carbon and the allied elements, of Berthelot on thermo-chemistry, of Bunsen on spectrum analysis, of Wüllner on the band- and line-spectra of the gases, and of Guthrie on the cryohydrates.

Cosmical chemistry is a science of yesterday, and yet it already abounds in facts of the highest interest. Hydrogen, which, if the absolute zero of the physicist does not bar the way, we may hope yet to see in the metallic form, appears to be everywhere present in the universe. It exists in enormous quantity in the solar atmosphere, and it has been discovered in the atmospheres of the fixed stars. It is present, and is the only known element of whose presence we are certain, in those vast sheets of ignited gas of which the nebulae proper are composed. Nitrogen is also widely diffused among the stellar bodies, and carbon has been discovered in more than one of the comets. On the other hand, a prominent line in the spectrum of the Aurora Borealis has not been identified with that of any known element; and the question may be asked—Does a new element, in a highly rarefied state, exist in the upper regions of our atmosphere? or are we, with Ångström, to attribute this line to a fluorescent or phosphorescent light produced by the electrical discharge to which the aurora is due? This question awaits further observations before it can be definitely settled, as does also that of the source of the remarkable green line which is everywhere conspicuous in the solar corona.

I must here pause for a moment to pay a passing tribute to the memory of Ångström, whose great work on the solar spectrum will always remain as one of the finest monuments of the science of our period. The influence, indeed, which the labours of Ångström and of Kirchhoff have exerted on the most interesting portion of later physics can scarcely be exaggerated; and it may be truly said that there are few men whose loss will be longer felt or more deeply deplored than that of the illustrious astronomer of Upsala.

I cannot pursue this subject further, nor refer to the other terrestrial elements which are present in the solar and stellar atmospheres. Among the many elements that make up the ordinary *aërolite*, not one has been discovered which does not occur upon this earth. On the whole we arrive at the grand conclusion that this mighty universe is chiefly built up of the same materials as the globe we inhabit.

In the application of science to the useful purposes of life, chemistry and mechanics have run an honourable race. It was in the valley of the Clyde that the chief industry of this country received, within the memory of many here present, an extraordinary impulse from the

application by Neilson of the hot blast to the smelting of iron. The Bessemer steel process and the regenerative furnace of Siemens are later applications of high scientific principles to the same industry. But there is ample work yet to be done. The fuel consumed in the manufacture of iron, as, indeed, in every furnace where coal is used, is greatly in excess of what theory indicates; and the clouds of smoke which darken the atmosphere of our manufacturing towns, and even of whole districts of country, are a clear indication of the waste, but only of a small portion of the waste, arising from imperfect combustion. The depressing effect of this atmosphere upon the working population can scarcely be overrated. Their pale— I had almost said etiolated—faces are a sure indication of the absence of the vivifying influence of the solar rays, so essential to the maintenance of vigorous health. The chemist can furnish a simple test of this state of the atmosphere in the absence of ozone, the active form of oxygen, from the air of our large towns. At some future day the efforts of science to isolate, by a cheap and available process, the oxygen of the air for industrial purposes may be rewarded with success. The effect of such a discovery would be to reduce the consumption of fuel to a fractional part of its present amount; and although the carbonic acid would remain, the smoke and carbonic oxide would disappear. But an abundant supply of pure oxygen is not now within our reach; and in the meantime may I venture to suggest that in many localities the waste products of the furnace might be carried off to a distance from the busy human hive by a few horizontal flues of large dimensions, terminating in lofty chimneys on a hill-side or distant plain? A system of this kind has long been employed at the mercurial mines of Idria, and in other smelting-works where noxious vapours are disengaged. With a little care in the arrangements the smoke would be wholly deposited, as flue-dust or soot, in the horizontal galleries, and would be available for the use of the agriculturist.

The future historian of organic chemistry will have to record a succession of beneficent triumphs, in which the efforts of science have led to results of the highest value to the wellbeing of man. The discovery of quinine has probably saved more human life, with the exception of that of vaccination, than any discovery of any age; and he who succeeds in devising an artificial method of preparing it will be truly a benefactor of the race. Not the least valuable, as it has been one of the most successful, of the works of our Government in India, has been the planting of the cinchona tree on the slopes of the Himalaya. As artificial methods are discovered, one by one, of preparing the proximate principles of the useful dyes, a temporary derangement of industry occurs, but in the end the waste materials of our manufactures set free large portions of the soil for the production of human food.

The ravages of insects have ever been the terror of the agriculturist, and the injury they inflict is often incalculable. An enemy of this class, carried over from America, threatened lately with ruin some of the finest vine districts in the South of France. The occasion has called forth a chemist of high renown; and in a classical memoir recently published, M. Dumas appears to have resolved the difficult problem. His method, although immediately applied to the *Phylloxera* of the vine, is a general one, and will no doubt be found serviceable in other cases. In the apterous state the *Phylloxera* attacks the roots of the plant, and the most efficacious method hitherto known of destroying it has been to inundate the vineyard. After a long and patient investigation, M. Dumas has discovered that the sulpho-carbonate of potassium, in dilute solution, fulfils every condition required from an insecticide, destroying the insect without injuring the plant. The process requires time and patience; but the trials in the vineyard have fully confirmed the experiments of the laboratory.

The application of artificial cold to practical purposes is rapidly extending; and, with the improvement of the ice-

machine, the influence of this agent upon our supply of animal food from distant countries will undoubtedly be immense. The ice-machine is already employed in paraffin works and in large breweries; and the curing or salting of meat is now largely conducted in vast chambers, maintained throughout the summer at a constant temperature by a thick covering of ice.

I have now completed this brief review, rendered difficult by the abundance, not by the lack of materials. Even confining our attention to the few branches of science upon which I have ventured to touch, and omitting altogether the whole range of pure chemistry, it is with regret that I find myself constrained to make only a simple reference to the important work of Cayley on the Mathematical Theory of Isomers, and to elaborate memoirs which have recently appeared in Germany on the reflection of heat and light-rays, and on the specific heat and conducting power of gases for heat, by Knoblauch, E. Wiedemann, Winkelmann, and Buff.

The decline of science in England formed the theme, fifty years ago, of an elaborate essay by Babbage; but the brilliant discoveries of Faraday soon after wiped off the reproach. I will not venture to say that the alarm which has lately arisen, here and elsewhere, on the same subject will prove to be equally groundless. The duration of every great outburst of human activity, whether in art, in literature, or in science, has always been short, and experimental science has made gigantic advances during the last three centuries. The evidence of any great failure is not, however, very manifest, at least in the physical sciences. The journal of Poggendorff, which has long been a faithful record of the progress of physical research throughout the world, shows no signs of flagging; and the *Jubelband* by which Germany celebrated the fiftieth year of Poggendorff's invaluable services was at the same time an ovation to a scientific veteran, who has perhaps done more than any man living to encourage the highest forms of research, and a proof that in Northern Europe the physical sciences continue to be ably and actively cultivated. If in chemistry the case is somewhat weaker, the explanation, at least in this country, is chiefly to be found in the demand on the part of the public for professional aid from many of our ablest chemists.

But whatever view be taken of the actual condition of scientific research, there can be no doubt that it is both the duty and the interest of the country to encourage a pursuit so ennobling in itself, and fraught with such important consequences to the wellbeing of the community. Nor is there any question in which this Association, whose special aim is the advancement of science, can take a deeper interest. The public mind has also been awakened to its importance, and is prepared to aid in carrying out any proposal which offers a reasonable prospect of advantage.

In its recent phase the question of scientific research has been mixed up with contemplated changes in the great universities of England, and particularly in the University of Oxford. The national interests involved on all sides are immense, and a false step once taken may be irretrievable. It is with diffidence that I now refer to the subject, even after having given to it the most anxious and careful consideration.

As regards the higher mathematics, their cultivation has hitherto been chiefly confined to the Universities of Cambridge and Dublin, and two great mathematical schools will probably be sufficient for the kingdom. The case of the physical and natural sciences is different, and they ought to be cultivated in the largest and widest sense at every complete university. Nor, in applying this remark to the English universities, must we forget that if Cambridge was the *Alma Mater* of Newton and Cavendish, Oxford gave birth to the Royal Society. The ancient renown of Oxford will surely not suffer, while her material position cannot fail to be strengthened, by the expansion of scientific studies and the encouragement of scientific research within her walls. Nor ought such a proposal to

be regarded as in any way hostile to the literary studies, and especially to the ancient classical studies, which have always been so carefully cherished at Oxford. If, indeed, there were any such risk, few would hesitate to exclaim—Let science shift elsewhere for herself, and let literature and philosophy find shelter in Oxford! But there is no ground for any such anxiety. Literature and science, philosophy and art, when properly cultivated, far from opposing, will mutually aid one another. There will be ample room for all, and, by judicious arrangements, all may receive the attention they deserve.

A University, or *Studium Generale*, ought to embrace in its arrangements the whole circle of studies which involve the material interests of society, as well as those which cultivate intellectual refinement. The industries of the country should look to the Universities for the development of the principles of applied as well as of abstract science; and in this respect no institutions have ever had so grand a possession within easy reach as have the universities of England at this conjuncture, if only they have the courage to seize it. With their historic reputation, their collegiate endowments, their commanding influence, Oxford and Cambridge should continue to be all that they now are; but they should, moreover, attract to their lecture halls and working cabinets students in large numbers preparing for the higher industrial pursuits of the country. The great physical laboratory in Cambridge, founded and equipped by the noble representative of the House of Cavendish, has in this respect a peculiar significance, and is an important step in the direction I have indicated. But a small number only of those for whom this temple of science is designed are now to be found in Cambridge. It remains for the University to perform its part, and to widen its portals so that the nation at large may reap the advantage of this well-timed foundation.

If the Universities, in accordance with the spirit of their statutes, or at least of ancient usage, would demand from the candidates for some of the higher degrees proof of original powers of investigation, they would give an important stimulus to the cultivation of science. The example of many Continental Universities, and among others of the venerable University of Leyden, may here be mentioned. Two proof essays recently written for the degree of Doctor of Science in Leyden, one by Van der Waals, the other by Lorenz, are works of unusual merit; and another pupil of Professor Rijke is now engaged in an elaborate experimental research as a qualification for the same degree.

The endowment of a body of scientific men devoted exclusively to original research, without the duty of teaching or other occupation, has of late been strongly advocated in this country; and M. Fremy has given the weight of his high authority to a somewhat similar proposal for the encouragement of research in France. I will not attempt to discuss the subject as a national question, the more so as after having given the proposal the most careful consideration in my power, and turned it round on every side, I have failed to discover how it could be worked so as to secure the end in view.

But whatever may be said in favour of the endowment of pure research as a national question, the Universities ought surely never to be asked to give their aid to a measure which would separate the higher intellects of the country from the flower of its youth. It is only through the influence of original minds that any great or enduring impression can be produced on the hopeful student. Without original power, and the habit of exercising it, you may have an able instructor, but you cannot have a great teacher. No man can be expected to train others in habits of observation and thought he has never acquired himself. In every age of the world the great schools of learning have, as in Athens of old, gathered around great and original minds, and never more conspicuously than in the modern schools of chemistry, which reflected the genius of Liebig, Wöhler, Bunsen, and Hofmann. These schools have been nurseries of original research as well as models

of scientific teaching; and students attracted to them from all countries became enthusiastically devoted to science, while they learned its methods from example even more than from precept. Will anyone have the courage to assert that organic chemistry, with its many applications to the uses of mankind, would have made in a few short years the marvellous strides it has done if Science, now as in mediæval times, had pursued her work in strict seclusion,—

*Semota ab nostris rebus, seiunctaque longe,
Ipsa suis pollens opibus, nil indiga nostri?*

But while the Universities ought not to apply their resources in support of a measure which would render their teaching ineffective, and would at the same time dry up the springs of intellectual growth, they ought to admit freely to university positions men of high repute from other universities, and even without academic qualifications. An honorary degree does not necessarily imply a university education; but it if have any meaning at all, it implies that he who has obtained it is at least on a level with the ordinary graduate, and should be eligible to university positions of the highest trust.

Not less important would it be for the encouragement of learning throughout the country that the English Universities, remembering that they were founded for the same objects, and derive their authority from a common source, should be prepared to recognise the ancient Universities of Scotland as freely as they have always recognised the Elizabethan University of Dublin. Such a measure would invigorate the whole university system of the country more than any other I can think of. It would lead to the strengthening of the literary element in the northern, and of the practical element in the southern universities, and it would bring the highest teaching of the country everywhere more fully into harmony with the requirements of the times in which we live. As an indirect result, it could not fail to give a powerful impulse to literary pursuits as well as to scientific investigations. Professors would be promoted from smaller positions in one university to higher positions in another, after they had given proofs of industry and ability; and stagnation, hurtful alike to professorial and professional life, would be effectually prevented. If this union were established among the old universities, and if at the same time a new university (as I myself ten years ago earnestly proposed) were founded on sound principles amidst the great populations of Lancashire and Yorkshire, the university system of the country would gradually receive a large and useful extension, and, without losing any of its present valuable characteristics, would become more intimately related than hitherto with those great industries upon which mainly depend the strength and wealth of the nation.

It may perhaps appear to many a paradoxical assertion to maintain that the industries of the country should look to the calm and serene regions of Oxford and Cambridge for help in the troublous times of which we have now a sharp and severe note of warning. But I have not spoken on light grounds, nor without due consideration. If Great Britain is to retain the commanding position she has so long occupied in skilled manufacture, the easy ways which (owing partly to the high qualities of her people, partly to the advantages of her insular position and mineral wealth) have sufficed for the past will not be found to suffice for the future. The highest training which can be brought to bear on practical science will be imperatively required; and it will be a fatal policy if that training is to be sought for in foreign lands because it cannot be obtained at home. The country which depends unduly on the stranger for the education of its skilled men, or neglects in its highest places this primary duty, may expect to find the demand for such skill gradually to pass away, and along with it the industry for which it was wanted. I do not claim for scientific education more than it will accomplish, nor can it ever replace the after-training of the workshop or factory. Rare and powerful minds have, it is true, often been independent of it; but high education

always gives an enormous advantage to the country where it prevails. Let no one suppose I am now referring to elementary instruction, and much less to the active work which is going on everywhere around us, in preparing for examinations of all kinds. These things are all very useful in their way, but it is not by them alone that the practical arts are to be sustained in the country. It is by education in its highest sense, based on a broad scientific foundation, and leading to the application of science to practical purposes—in itself one of the noblest pursuits of the human mind—that this result is to be reached. That education of this kind can be most effectively given in a university, or in an institution like the Polytechnic School of Zürich, which differs from the scientific side of a university only in name, and to a large extent supplements the teaching of an actual university, I am firmly convinced; and for this reason, among others, I have always deemed the establishment in this country of Examining Boards with the power of granting degrees, but with none of the higher and more important functions of a university, to have been a measure of questionable utility. It is to Oxford and Cambridge, widely extended as they can readily be, that the country should chiefly look for the development of practical science; they have abundant resources for the task, and if they wish to secure and strengthen their lofty position, they can do it in no way so effectually as by showing that in a green old age they preserve the vigour and elasticity of youth.

If any are disposed to think that I have been carrying this meeting into dream-land, let them pause and listen to the result of similar efforts to those I have been advocating, undertaken by a neighbouring country when on the verge of ruin, and steadily pursued by the same country in the climax of its prosperity. "The University of Berlin," to use the words of Hofmann, "like her sister of Bonn, is a creation of our century. It was founded in the year 1810, at a period when the pressure of foreign domination weighed almost insupportably on Prussia; and it will ever remain significant of the direction of the German mind that the great men of that time should have hoped to develop, by high intellectual training, the forces necessary for the regeneration of their country." It is not for me, especially in this place, to dwell upon the great strides which Northern Germany has made of late years in some of the largest branches of industry, and particularly in those which give a free scope for the application of scientific skill. "Let us not suppose," says M. Wurtz in his recent Report on the Artificial Dyes, "that the distance is so great between theory and its industrial applications. This report would have been written in vain, if it had not brought clearly into view the immense influence of pure science upon the progress of industry. If unfortunately the sacred flame of science should burn dimly or be extinguished, the practical arts would soon fall into rapid decay. The outlay which is incurred by any country for the promotion of science and of high instruction will yield a certain return; and Germany has not had long to wait for the ingathering of the fruits of her far-sighted policy. Thirty or forty years ago industry could scarcely be said to exist there; it is now widely spread and successful." As an illustration of the truth of these remarks I may refer to the newest of European industries, but one which in a short space of time has obtained considerable magnitude. It appears (and I make the statement on the authority of M. Wurtz) that the artificial dyes produced last year in Germany exceeded in value those of all the rest of Europe, including England and France. Yet Germany has no special advantage for this manufacture except the training of her practical chemists. We are not, it is true, to attach undue importance to a single case; but the rapid growth of other and larger industries points in the same direction, and will, I trust, secure some consideration for the suggestions I have ventured to make.

The intimate relations which exist between abstract science and its applications to the uses of life have always

been kept steadily in view by this Association, and the valuable Reports, which are a monument to the industry and zeal of its members, embrace every part of the domain of science. It is with the greater confidence, therefore, that I have ventured to suggest from this Chair that no partition-wall should anywhere be raised up between pure and applied science. The same sentiment animates our vigorous ally, the French Association for the Advancement of Science, which rivaling, as it already does, this Association in the high scientific character of its proceedings, bids fair in a few years to call forth the same interest in science and its results, throughout the great provincial towns of France, which the British Association may justly claim to have already effected in this country. No better proof can be given of the wide base upon which the French Association rests than the fact that it was presided over last year by an able representative of commerce and industry, and this year by one who has long held an exalted position in the world of science, and has now the rare distinction of representing in her historic Academies the literature as well as the science of France.

Whatever be the result of our efforts to advance science and industry, it requires no gift of prophecy to declare that the boundless resources which the supreme Author and Upholder of the Universe has provided for the use of man will, as time rolls on, be more and more fully applied to the improvement of the physical—and, through the improvement of the physical, to the elevation of the moral—condition of the human family. Unless, however, the history of the future of our race be wholly at variance with the history of the past, the progress of mankind will be marked by alternate periods of activity and repose; nor will it be the work of any one nation or of any one race. To the erection of the edifice of civilised life, as it now exists, all the higher races of the world have contributed; and if the balance were accurately struck, the claims of Asia for her portion of the work would be immense, and those of Northern Africa not insignificant. Steam-power has of late years produced greater changes than probably ever occurred before in so short a time. But the resources of Nature are not confined to steam, nor to the combustion of coal. The steady water-wheel and the rapid turbine are more perfect machines than the stationary steam-engine; and glacier-fed rivers with natural reservoirs, if fully turned to account, would supply an unlimited and nearly constant source of power depending solely for its continuance upon solar heat. But no immediate dislocation of industry is to be feared, although the turbine is already at work on the Rhine and the Rhone. In the struggle to maintain their high position in science and its applications, the countrymen of Newton and Watt will have no ground for alarm so long as they hold fast to their old traditions, and remember that the greatest nations have fallen when they relaxed in those habits of intelligent and steady industry upon which all permanent success depends.

At the conclusion of the Address the DUKE OF AROYLL said—I rise for the purpose of asking you to record a vote of earnest and hearty thanks to our distinguished President for the most able and instructive Address which he has just delivered. The President has modestly called a great part of his Address a brief review of the recent triumphs of science. No one knows better than our distinguished President the utter impossibility, within the short space to which a presidential address is necessarily confined, of giving an adequate idea of the immense activities of modern science. But those who look carefully over this review, slight as the sketch may be held to be, will see that it is a sketch drawn by a master hand. It gave us a few points, but they are the salient points of recent discovery; they were told in close connection with each other, and above all they were told in that most valuable of all connections in relation to our duty as members of the

British Association—in the connection between that which has been already done and that which it still remains to do. There was one very remarkable passage of our President's Address—I do not know whether it has attracted your attention as much as it attracted mine—in which he referred, lightly indeed, but significantly, to a notion that there is at present a danger of decline in the scientific activities of England, and, he added, that the periods of great intellectual activity in the human mind are almost always short. This may be true, and I am inclined to think that if the remark is applied to literature it is true, but my own impression is that as applied to science it is not true. We are at the present moment living in a golden age of scientific inquiry. As regards literature, it was only last week that I had the opportunity of conversing on the subject with a most distinguished man, who perhaps among many others was most able to appreciate the matter of which he spoke, and he gave it as his impression that as regards literature and philosophy there was a marked decline in eminence and ability, and certainly if we compare the state of literature now with the burst of genius which illustrated the close of last century and the first twenty-five years of the present we may be inclined to come to that conclusion, for where is the galaxy that will compare with Burns, Scott, Wordsworth, Southey, and Campbell? But when we come to science I rejoice to think that the contrast is remarkable indeed. Let me just remind this great assembly of the names of the living, and the men who have lately left us. In geology we have names—the grave has only just closed over them—the names of Murchison and Sedgwick, of a Lyell and Phillips; and I need hardly say that in those we have a group of names in whose powerful hands a branch of inquiry which but a few years ago was a ridicule and a discredit has risen to be one of the most popular and most certain sciences which illustrate the progress of the human mind. Then, again, physics. It is not very long ago that we had Faraday, and I rejoice to say we have still yourself, Mr. President. Again, in natural history we have Darwin and Walton, and even those who may not accept—and I am one of those who do not accept—the special theory of Mr. Darwin as a satisfactory explanation of the deepest mystery of nature,—namely, the history of creation. Even those who do not accept that theory must admit that Mr. Darwin stands *à* among the naturalists of the world. So, also, in comparative anatomy. On this platform, in all these departments of science we have assembled to-night men whom I do not name because they are present, and because they are personal friends of many of us, but whose names will be a household word in every home of science during generations which are yet unborn. Therefore, I repeat, we have no reason to fear any decline in intellectual activity so far as the discoveries and progress of science are concerned; and this brings me to another observation of the President's, to which I confess I attach special value. I thank you for the wise and weighty words which you have spoken upon the vexed question of the endowment of research. I sometimes wonder if those who call for the endowment of research have ever thought what real scientific research is. You may pay and pension men for the mere collecting and asorting of dry facts, but you cannot command by your pensions or emoluments that fire of genius, that intuition of the mind, which is the secret of all true and real scientific research. I should deeply deplore to see the day when scientific research was to depend for its appointments and the selection of its favourites upon any Minister or any Government. There is, indeed, another department of the endowment of research in which I think it may take a powerful and useful part, and I cannot illustrate that department better than by referring to the fitting out of the "Challenger" Expedition. You all know that my hon. friend and former colleague, Mr. Robert Lowe, was considered one of the hardest-fisted Chancellors of the Exchequer who ever filled the office, but he has a highly

educated mind. He knows as well as any man the things which private enterprise should be expected to undertake and what individual means cannot accomplish, and therefore he at once assented to the sending out of that great expedition, which, I believe, will be found to have added immensely to our knowledge of the secrets of nature. There is only one other observation in your Address, Mr. President, to which I would direct the attention of this meeting before I move the resolution of thanks, and it was that passage in which you spoke of there being no wall of partition between abstract and applied sciences—do not let us ever quit hold of the ground that the true spirit of science is to be found in the love of knowledge for its own sake. Applications are sure to follow applications infinitely greater in number and amount than any human imagination could conceive beforehand; but we pursue science for its own sake, thankful and grateful for the benefits to mankind which it scatters around with so lavish a hand. And let me say, Mr. President, you might have added, let there be no wall of partition between science strictly so-called and speculative philosophy. I am sure you will be inclined to agree with me when I say that one of the dangers of our modern science, arising from its very vitality and spirit and energy and growth, is the tendency to let speculation outrun knowledge. But the remedy for this is not to bar the way against abstract speculation of any kind, not to forbid or ostracise it in our halls of science, but rather to encourage it, and to remind scientific men, to remind ourselves, and to remind the world that after all our discoveries how very little our knowledge is; and where science has discovered this she will recognise her proper sphere, and philosophy will be chastened and subdued. The noble Duke concluded by moving the thanks of the Association to their distinguished President for his admirable Address.

The motion was seconded by SIR WM. THOMSON, and was carried by acclamation.

ADDRESS TO THE CHEMICAL SECTION

BY

WILLIAM HENRY PERKIN, F.R.S.,

President of the Section.

THERE can be no doubt that chemistry and the allied sciences are now being recognised to a much greater extent in this country than in former years; and not only so, the workers at research, though still small in number, are more numerous than they were.

In 1868 Dr. Frankland, in his Address to this Section at the Meeting at Norwich, commented upon the small amount of original research then being carried on in the United Kingdom; but, judging from the statistics of the Chemical Society, this state of things became even worse, for in 1868 there were forty-eight papers read before the Society, but in 1872 only twenty-two. Since then, however, there has been a considerable increase in the number; and at the Anniversary Meeting in March last it was shown that the number of communications for the Session had risen to sixty-six, or three times as many as in 1872.

Of course these figures only refer to the Chemical Society, but I think they may be taken as a very safe criterion of the improved state of things, though it would be very gratifying to see much greater activity.

It is also very pleasing to find that the aids to and opportunities for research are increasing, because it must be remembered that, in a pecuniary sense, science is far from being its own rewarder at the time its truths are being studied, although the results very often become eventually of the greatest practical value; hence the wisdom of a country encouraging scientific research.

But little, however, has been done in this direction in past years—the grants made for general science by this Association, and that of the Government of one thousand pounds annually to the Royal Society, being the most important.

The Chemical Society has also been in the habit of giving small grants for the purpose of assisting those engaged in chemical research. In the future, however, it will be able to do much more than hitherto. One of the original members of the Society, Dr. Longstaff, offered in the early part of the year to give one thousand pounds provided a similar sum could be raised, the united amount to be invested and the interest applied for the encouragement of research. I am happy to say that rather more than the required sum has been raised, and it is hoped that it may be still further supplemented.

In addition to the Royal Society grant, the Government have given this year a further annual sum of four thousand pounds. Of course this is for science generally.

Mr. T. J. Phillips Jodrell has also placed at the disposal of the Royal Society the munificent sum of six thousand pounds, to be applied in any manner that they may consider for the time being most conducive to the encouragement of research in physical sciences.

When we consider how much of our science is of a physical nature we must be grateful for this bequest; and it is to be hoped that these helps will more and more stimulate research in the United Kingdom; and if we have any hope of keeping pace with the large amount of work now being carried on in other countries, we must indeed be energetic.

The employment of well-trained chemists in chemical works is now becoming much more general than heretofore, especially on the Continent, where in some cases a considerable staff is employed and provided with suitable appliances, for the purpose not only of attending to and perfecting the ordinary operations which are in use, but to make investigations in relation to the class of manufacture they are engaged in. A conviction of the necessity of this is gaining strength in this country, though not so quickly as might be desired; nevertheless these things are encouraging.

With reference to the progress of chemistry and what have been the fruits of research of late years, it will be impossible for me to give even a general outline, the amount of work being so large; in fact, to recount the list of investigations made during the past year would take up most of the time at my disposal.

Amongst the most interesting, perhaps, are those relating to isomerism, especially in the aromatic series of organic bodies; and it is probable that a more intimate knowledge of this subject will be found of really practical value.

As I am unable to give an account of the work done during the past year on account of its extent and diversity, I propose to refer to some of the practical results which have already accrued from Organic Chemistry, as a plea for the encouragement of research; and those I intend to speak of are of special interest also on account of their close connection with the textile manufactures of Great Britain. I need scarcely say I refer to the colouring-matters which have been obtained from the products found in tar.

It was in 1856, now twenty years since, that this industry was commenced by the discovery of the "mauve" or "aniline purple;" and it may be of interest to state that it was in Scotland, in the autumn of the same year, that the first experiments upon the application of this dye to the arts of dyeing and calico-printing were made, at Perth and Maryhill.

I need scarcely remind you of the wonderful development of this industry since then, seeing we now have from the same source colouring-matters capable of producing not only all the colours of the rainbow, but their combinations. I wish, however, to briefly refer to the date and origin of the products which have served to build up this great industry.

It was in 1825 that Faraday published, in the *Philosophical Transactions*, his research on the oily products separated in compressing oil-gas, and described a substance he obtained from it—a volatile colourless oil, which he called Bicarburetted Hydrogen. Mitscherlich some years afterwards obtained the same substance from benzoic acid, and gave it the name it bears, viz., "Benzol." This same chemist further obtained from benzol, nitrobenzol, by acting upon it with nitric acid. Zinin afterwards studied the action of reducing agents upon nitrobenzol, and obtained "aniline," which he at that time called Benzidam.

Again, Pelletier and Walter discovered the hydrocarbon toluol in 1837. Deville produced its nitro-compound in 1841; and Hofmann and Muspratt obtained from this "toluidine," by the process used by Zinin to reduce nitrobenzol.

I might mention other names in connection with these substances, such as Runge and Unverdorben; but I would now ask, Did any of these chemists make these investigations with the hope of gain? was it not rather from the love of research, and that alone? and now these products, which were then practically useless, are the basis of the aniline colours. But to go further: Doebereiner a long while ago obtained from alcohol a substance which he called "light oxygen ether," now known as aldehyd. Gay-Lussac produced iodide of ethyl in 1815. Dumas and Peligot discovered the corresponding substance iodide of methyl in 1835; but, as in the cases I have previously referred to, these bodies had no practical value, and were never prepared but in the laboratory. Hofmann, in his researches on the molecular constitution of the volatile organic bases, discovered in 1850 the replacement compounds of aniline containing alcohol radicals.

All these compounds have now been manufactured on the large scale, and used in the further development of the industry of these artificial colouring-matters.

Other substances might be mentioned; but I think these are sufficient to show how the products of research which, when first discovered and for a long period afterwards, were of only scientific interest, at last became of great practical value; and it is evident that, had not the investigations and discoveries I have referred to been made as they were solely from a love of science, no aniline colours would now be known.

The colouring-matters I have hitherto spoken of are nitrogenous, and derived from benzol and its homologues. There are a few others, however, of the same origin which contain no nitrogen; but they are of secondary importance.

I now pass on to another class of colouring-matter, which is obtained from anthracen, a coal-tar product differing from benzol and toluol in physical characters, inasmuch as it is a magnificent crystalline solid.

The first colouring-matter derived from anthracen which I wish to draw your attention to, is alizarin, the principal dyeing agent found in madder-root. This substance was for a long time supposed to be related to naphthalin, inasmuch as phthalic acid can be produced from both of them; and many were the experiments made by chemists in this direction; it was not, however, until 1868 that this was proved to be a mistake, and its relationship to anthracen was discovered by Graebe and Liebermann, who succeeded in preparing this coal-tar product from the natural alizarin itself.

Having obtained this important result, they turned their attention further to the subject, hoping to find some process by which alizarin could be produced from anthracen; in this they were soon successful.

The discovery of the artificial formation of alizarin was of great interest, inasmuch as it was another of those instances which have of late years become so numerous, namely, the formation of a vegetable product artificially; but the process used by Graebe and Liebermann was of little practical value, because too expensive for practical purposes.

Having previously worked on anthracen derivatives, it occurred to me to make some experiments on this subject, which resulted in the discovery of a process by which the colouring-matter could be economically produced on a large scale. Messrs. Caro, Graebe, and Liebermann about the same time obtained similar results in Germany; this was in 1869. Further investigation during that year yielded me a new process, by which "dichloranthracen" could be used in place of the more costly product anthraquinon, which was required by the original processes. I mention this, as most of the artificial alizarin used in this country up to the end of 1873, and a good deal since, has been prepared by this new process.

It was observed that when commercial artificial alizarin prepared from anthraquinon, but more especially from dichloranthracen, was used for dyeing, the colours produced differed from those dyed with madder or pure alizarin; and many persons therefore concluded that the artificial colouring-matter was not alizarin at all. This question, however, was set at rest by separating out the pure artificial alizarin from the commercial product and comparing it with the natural alizarin, when it was found to produce exactly the same colours on mordanted fabrics, to have the same composition, to give the same reactions with reagents, and to yield the same products on oxidation.

But whilst examining into this subject it was found that a second colouring-matter was present in the commercial product, and in somewhat large quantities, especially when dichloranthracen had been employed in its preparation; and to this was due the difference in shade of colour referred to.

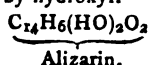
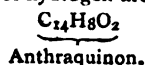
This substance, when investigated, was found to have the same composition as "purpurin," also a colouring-matter found in madder, but of very little value on account of the looseness and dulness of some of the colours it produces. This new substance, being derived from anthracen, was named anthrapurpurin; unlike its isomer purpurin, however, it is of great value as a colouring-matter. I do not think I shall be going beyond the results of experience if I say it is of as great importance as alizarin itself; with alumina mordants it produces reds of a more scarlet or fiery red than those from alizarin. In fact, so fine are the colours produced that, with ordinary alumina mordants on unbleached cotton, it gives results nearly equal in brilliancy to Turkey-red produced with madder or garancin; and I believe the rapid success of artificial alizarin was greatly due to its presence. Most of that consumed at first was for Turkey-red dyeing; and the colours were so clear that it was mostly used in combination with madder or garancin, to brighten up the colours produced by these natural products.

The purple colours anthrapurpurin produces with iron mordants are bluer in shade than those of alizarin, and the blacks are very intense. Its application is practically the same as alizarin, so that they can be used in combination.

As already noticed, the commercial product called "artificial alizarin" first supplied to the consumer was always a mixture of alizarin and anthrapurpurin; and various mixtures of these two colouring-matters are still sent into the market; but, owing to the investigations that have been made and the study and attention that has been given to it by manufacturers, nearly pure alizarin and anthrapurpurin are also sent into the market—the first being known as "blue-shade alizarin," and the second as red or "scarlet alizarin."

The formation of anthrapurpurin in the manufacture of alizarin may to some extent be said to have arisen from a want of knowledge of the true conditions required for the production of the latter.

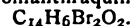
It is now well known that alizarin is a dioxyanthraquinon, or, in other words, anthraquinon in which two atoms of hydrogen are replaced by hydroxyl.



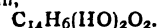
If we want to introduce hydroxyl into a compound, there are several processes which can be used; but I will only refer to those connected with the history of this colouring-matter.

The first process which I will refer to has been used by chemists for a long period. It consists in first replacing the hydrogen by bromine, and then treating the resulting body with potassic or other metallic hydrate; and according as one, two, or more atoms of hydrogen have been replaced by the bromine, so on its removal by the metal of the metallic hydrate, a compound containing a corresponding number of atoms of hydrogen replaced by hydroxyl is obtained.

Graebe and Liebermann acted upon this principle in their experiments on the artificial formation of alizarin; and as it was necessary to replace two atoms of hydrogen in anthraquinon, they first of all prepared a dibrominated derivative, called dibromanthraquinon,



By decomposing this with potassic hydrate at a high temperature, they obtained a violet-coloured product, which, when acidified to remove the alkali, gave a yellow precipitate of alizarin,



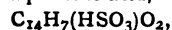
The second process I wish to speak of for the replacement of hydrogen by hydroxyl in a compound is by converting it into a sulpho-acid (usually by means of sulphuric acid) and subsequently decomposing this with potassic or other hydrate; and, according as a mono- or disulpho-acid is employed, it yields on decomposition a compound with one or two atoms of hydrogen replaced by hydroxyl.

The discovery of sulpho-acids of anthraquinon, and their use in place of the brominated derivative originally employed by Graebe and Liebermann, constituted the great improvement in the manufacture of alizarin already referred to.

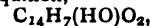
From what has just been stated, it was naturally supposed that a disulpho-acid of anthraquinon would be required to produce alizarin, and this was believed to be the case for some time; but further experiments have proved it to be a mistake, and shown that the mono-sulpho acid is required to produce alizarin, the disulpho-acid yielding anthrapurpurin.

But how are we to explain this apparent anomaly? It would take up too much time to enter into a discussion respecting the constitution of the sulpho-acids of anthraquinon in reference to the position of the HSO_3 groups. I will therefore confine my remarks to their decomposition.

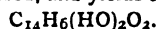
Monosulphoanthraquinonic acid,—



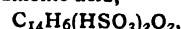
when heated strongly with caustic alkali, as potassic or sodic hydrate, decomposes in the ordinary way, and we get "monoxyanthraquinon,"—



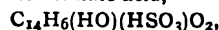
which is a yellow body possessing no dyeing properties. On further treating this, however, with caustic alkali it changes, being oxidised, and yields alizarin,—



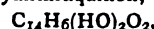
Disulphoanthraquinonic acid,—



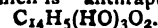
when subjected to the influence of caustic alkali, at first changes into an intermediate acid,—



and then into a dioxyanthraquinon,—



now known as "isoanthraflavic acid,"—a substance having the same composition as alizarin, but being only an isomer of that body, and possessing no affinity for mordants. Like monoxyanthraquinon, however, when further heated with alkali it becomes oxidised, and yields a colouring matter, which is "anthrapurpurin,"—



Looking at these reactions, it appears rather remarkable that Graebe and Liebermann should have succeeded in preparing alizarin from dibromanthraquinon. It can only be explained on the assumption that the hydrogen atoms replaced in the disulpho-acid are different in position from those replaced in the dibromanthraquinon; and of course it is possible that a disulpho-acid isomeric with that now known may be discovered that will yield alizarin as a first product on treatment with alkali.

In the reaction which takes place when monoxanthraquinon or isanthraflavic acid become oxidised and change into alizarin and anthrapurpurin nascent hydrogen is formed; and this causes a reverse action to take place—ordinary anthraquinon, or its hydrogen derivative, being formed, and a loss of colouring matter resulting. A small amount of potassic chlorate is now used with the caustic alkali, just sufficient to overcome the reducing action, which has resulted in an increased yield of colouring matter, the percentage obtained being now not very much below the theoretical quantity.

When the process for making commercial artificial alizarin by treating anthraquinon with sulphuric acid was first adopted, the product from that treatment was a mixture of the mono- and disulpho-acids of anthraquinon. Consequently, the colouring matter prepared in this manner was a mixture of alizarin and anthrapurpurin; and the reason why dichloranthracen, when used in place of anthraquinon, yields a product very rich in anthrapurpurin, is on account of the readiness with which it forms a disulpho-acid of dichloranthracen, which afterwards changes into the disulpho-acid of anthraquinon.

At first it was supposed by many that the quantity of coal-tar produced would not yield a sufficient supply of anthracen for the manufacture of artificial alizarin. Experience has, however, proved that this supposition was groundless, as now the supply is greater than the demand.

Moreover, some very interesting experiments have lately been made, by which anthraquinon and its derivatives have been obtained without the use of anthracen. The most interesting are those in which phthalic anhydride is employed with benzoic derivatives: for example, this anhydride gives with hydroquinon a colouring matter having the same composition, as well as most of the other properties of alizarin. It is called quinizarin. Baeyer and Caro have also obtained from phthalic anhydride and phenol oxyanthraquinon, and by using pyrocatechin in place of phenol they got alizarin itself.

Although these products have not been obtained in sufficient quantities by these processes to be of any practical value, we do not know what further research may do. Already one of the substances used is being prepared on the large scale for the manufacture of that beautiful colouring matter "eosin;" I refer to phthalic anhydride.

Now, with reference to the origin of the products which are used for the manufacture of artificial alizarin, we find the first researches made in reference to anthracen were by Dumas and Laurent in 1832; subsequently, Laurent further worked upon this subject, and obtained, by the oxidation of this hydrocarbon, a substance which he called anthracenuse; he also obtained dichloranthracen. Dr. Anderson also made an investigation on anthracen and its compounds in 1863, and assigned to it its correct formula; he re-examined its oxidation product, which Laurent called anthracenuse, and named it oxyanthracen, the substance we now know as anthraquinon.

All these substances were without any practical value until 1868; but we now find them of the greatest importance, and used daily in immense quantities.

But to bring out more clearly the practical importance of these fruits of scientific research, it will be well perhaps to see what has been their influence on the colouring matters which were in use before them, and also the extent of their present consumption.

The influence of the so-called aniline colours on dye-woods, &c., has been remarkably small. It is true that at first magenta had a depreciating influence upon cochineal;

but this has passed away, and now the consumption of that dye is as great as ever; certainly its price is much lower than it used to be, but this is due to a variety of causes, especially the great increase in the cultivation of the insect at Teneriffe. And perhaps this want of influence is not so very remarkable when we consider the aniline colours are entirely new products, differing in composition and properties from the old colouring matters, and therefore could only displace them to a certain extent.

But whilst this is the case, the aniline colours have been more and more used, until at present it is computed that their annual sale in the United Kingdom and on the Continent exceeds £2,000,000. This is probably due to new applications and increase of trade.

When, however, we come to consider the influence of the anthracen colours, alizarin and anthrapurpurin, more generally known as "artificial alizarin," we find we have a very different tale to tell.

Here, in the case of alizarin, we have a competition not between two colouring matters, but the same from different sources—the old source being the madder-root, the new one coal-tar. And when we introduce the consideration of anthrapurpurin, which produces such magnificent reds, much brighter than alizarin or ordinary purpurin, we see we have not only a replacement but an improvement, so that these new colouring matters throw the old ones into the shade. The products being purer, the clearing processes for goods dyed with them are also necessarily easier and simpler.

It will be interesting to examine into the statistics of the madder and garancin trade in a brief manner, to see what has been the influence of artificial alizarin on their consumption. The following figures are mostly calculated from the Board of Trade returns.

During the ten years immediately preceding the introduction of artificial alizarin the average annual imports of madder into the United Kingdom were 15,292 tons, and of garancin 2778 tons. Estimating the value of the former at £2 2s. 6d., and the latter at £8 per cwt., which were about the average prices during that period, the annual value in round numbers was about one million sterling.

The introduction of artificial alizarin, however, has so influenced the value of madder that its price is now less than one-half; and thus a saving of over half a million sterling per annum has been effected to the manufacturers of the United Kingdom, one-half of which may be put down to Glasgow.

So much for its effect in reducing prices; but what has been its influence on the consumption of these dye-stuffs?

I have already stated the average quantity of these substances imported per annum prior to the discovery of the artificial product, and will now compare it with the imports of last year and this. That for the present year of course is an estimated quantity, and calculated from the returns for the first seven months.

	Average Annual Imports.		
	1859—1868. Tons.	1875. Tons.	1876. Tons.
Madder	15,292	5014	3653
Garancin	2778	1293	813

These figures speak for themselves.

The money value, which was formerly £1,000,000 per annum, is now, calculating from the estimated quantity for the year, only £138,105, say £140,000, taking garancin at £4 per cwt. and madder at £1 per cwt., prices slightly in excess of their present value.

At the present prices the cultivation of madder-roots is unremunerative; and it is to be expected that madder-growing will soon be a thing of the past, thousands of acres of land being at the same time liberated for the growth of those products which we cannot produce artificially, and without which we cannot exist. The quantity of madder grown in all the madder-growing countries of the world prior to 1868, was estimated to be 70,000 tons per annum; and at the present time the artificial colour is manufactured to an extent equivalent to 50,000 tons, or

more than two-thirds of the quantity grown when its cultivation had reached its highest point.

I might have referred to other subjects besides the coal-tar colours which have resulted from scientific research; but I know of no other of such interest and magnitude. From the brief history I have given, we see that the origin of these colouring-matters is entirely the fruit of many researches made quite independently by different chemists, who worked at them without any knowledge of their future importance; and on looking at the researches which have thus culminated in this industry, it is interesting to notice that many, if not most of them, were conducted for the purpose of elucidating some theoretical point.

These facts certainly ought to be a great encouragement to chemists, and stimulate them to greater activity. It would be very pleasing to see more work emanating from the chemical schools of the United Kingdom; and I think no student should consider his chemical curriculum finished until he has conducted an original research. The knowledge obtained by a general course of instruction is of course of very great value; but a good deal of it is carried on by rule. In research, however, we have to depend upon the exercise of our judgment, and, in fact, of all our faculties; and a student having once conducted even one, under the guidance of an efficient director, will find that he has acquired an amount of experience and knowledge which will be of the greatest value to him afterwards.

It is hoped these remarks will encourage young chemists to patiently and earnestly work at whatever subject they may undertake, knowing that their results, although sometimes apparently only of small interest, may contain the germ of something of great scientific or practical importance, or may, like a keystone in an arch, complete some subject which before was fragmentary and useless.

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ON THE TRIPOLITE OF BARBADOES.

By Dr. T. L. PHIPSON, F.C.S., &c.

A most remarkable deposit of tripolite exists in the island of Barbadoes, where it is mixed with a certain quantity of carbonate of lime. Under the microscope it is found to be exceedingly rich in remains of fossil infusoria, the forms of which are very well preserved. The silica is hydrated and soluble to a great extent in potash solution, and, like tripolite from other localities, it constitutes an excellent polishing material. On account of its value in

this respect tripolite has many imitations in commerce, but it can be recognised at once by analysis, and also by the microscope. Below I give my analysis of a Barbadoes sample (a fair sample from many cwts. of this wonderful deposit) and that of a Swedish sample, together with two kinds of imitation tripolite met with in London:—

	Barbadoes.	Dagesfors, Sweden.
Silica	71.50	78.00
Oxide of iron and alumina ..	2.32	
Carbonate of lime	10.60	6.15
Phosphoric acid	0.08	
Combined water, with a } minute quantity of organic } matter	9.84	15.85
Moisture	5.66	
	100.00	100.00

	Imitations.	
Silica	1.0	84.7
CaOCO ₂	88.4	6.1
Fe ₂ O ₃ , &c.	5.6	4.8
Water	5.0	4.4
	100.0	100.0

A sample of genuine tripolite from the Puy de Dome (France) gave:—Fournier: Silica, 87.2; water, 10.0; alumina, oxide of iron, &c., 2.8. Another sample from Algiers gave:—Salvétat: Silica, 80.0; water, 9.0; oxide of iron, alumina, lime, &c., 10.0. In all cases the silica is mostly soluble in strong boiling alkaline ley.

The genera most easily recognised in these deposits, with the aid of a moderately powerful microscope (200 to 260 diameters) are *Desmidium*, *Euastrum*, *Xantidium*, *Peridinium*, *Gomphonema*, *Hemantidium*, *Pinnularia*, *Navicula*, *Actinocyclus*, *Pixidula*, *Gallionella*, *Synedra*, and *Bacillaria*. I have italicised those which appear to me most prominent in the Barbadoes deposit. Of these, *Gallionella*, *Desmidium*, *Bacillaria*, and *Navicula* are supposed to be plants, all the others to be animals. The great resemblance of these fossil animalcules to some of the active little beings in our ditches and stagnant waters is very striking.

Among other useful purposes to which the Barbadoes tripolite has been applied latterly, we may mention that, having been found a bad conductor of heat, it has been used with advantage for covering boilers. Boettger says tripolite will displace the aniline colours from their solution in spirit and fix them so that after awhile the solution filters colourless.

Laboratory of Analytical Chemistry,
Putney, S.W.

THERMOCHROMATISM, OR HEAT COLOURATION.

By MAJOR W. A. ROSS, late R.A.

MANY months ago, soon after the South Kensington Museum purchased a copy of my work, "Pyrology, or Fire Chemistry," in December, 1875, Mr. Valentin informed me in the chemical laboratory of that Museum that Mr. Ackroyd (one of his pupils) was "examining" my "ingenious" hypothesis published in that work as to the cause of the colours assumed by some heated substances.

I have just seen in the *CHEMICAL NEWS* (vol. xxxiv., p. 75) the result of this examination in an article called "Metachromatism," in which, however, my name is not mentioned, and ask you to do me the justice to publish

similarly in your valuable paper the following examination of his examen.

(1.) The term "metachromatism" applied to a temporary alteration of colour, is obviously a misnomer, for, without that adjective, it implies a chronic change; a substitution, in fact, of one colour for another, which phenomenon does not take place in the majority of these cases, while the principal producing agent—heat—remains in it utterly unrepresented. But while the term "metachromatism" is, as applied to heated bodies, in itself erroneous, what are we to think of the derivative "metachrome" with which, Mr. Ackroyd tells us, it will be "convenient" to label all "colour-changing" bodies? I should think, on the contrary, such a phraseology would be highly inconvenient, and might lead to serious results, if, for instance, a young gentleman, about to "pop the question," were to call the blushing "object of his affections" a "metachrome;" while the analogous misuse of classical derivatives would lead us to call a man a "poudinerement," because he has temporarily increased his weight by eating roast beef and plum pudding.

(2.) The term "thermochromatism" would therefore seem more suitable for this class of phenomena than that proposed by Mr. Ackroyd, while I cannot but think that the intolerable confusion between ideas of function and of form, implied by his other term "metachrome," should be carefully avoided.

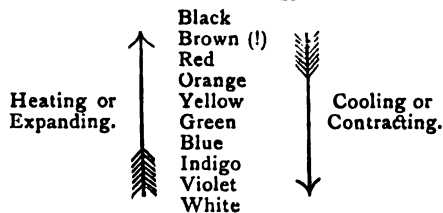
(3.) Although Mr. Ackroyd has not made the faintest reference to the article on colour in my published work above mentioned, which, according to Mr. Valentin, led to his investigations, he has, notwithstanding, done me the honour, under the disguise of a cloud of high-sounding but rather pedantic and frothy phrases, as "atomic potentiality," &c.—to come in the end to precisely the same conclusions as those recorded in my work; and to make this fact apparent, I make the following quotations:—

"PYROLOGY," p. 114 (1875).

"Substances whose particles can be agitated by vibrations of any kind, however minute, must have spaces between these, or pores; and if we can imagine vibrations having different amplitudes, it would not be difficult to assume the fact of pores having a corresponding magnitude, into some of which, for instance, waves of a comparatively greater amplitude, as red, could not pass, while violet vibrations would be freely admitted. If, then, we conceive an *expansion* of such light pores of heat, the rays of greater amplitude (of vibration) would pass into the *hot* body, and be gradually excluded as that cooled. It is a curious fact, with regard to this hypothesis, that oxide of bismuth—a metal which *expands* in cooling—proceeds in the other chromatic direction in cooling, viz., from *D₄*, or yellow, to white." This description is illustrated by a coloured lithograph (Plate II. of the work) representing a circular chromatic scale of the prismatic colours, with Fraunhofer's lettering, in which A, or red, exhibits the limit of coloured expansion, and H δ , or violetish red, the limit of coloured contraction; and these limits are surrounded by dotted arrows, showing the procedure of heated metallic oxides in either direction. White (as being the combination of all colours) concludes the scale at the limit of expansion, and black (as an absence of light) at that of contraction.

MR. ACKROYD (1876).

"Hence when, at an early stage in its study, I saw that nearly all metachromatic changes take place in a definite order—the order of the spectrum colours—I was under the impression, even after much reading, that the subject was quite unworked. . . . Expansion by heat is an all but universal law, so far as we at present know. . . . Both classes (of oxides) alike owe their change to increased absorption of light, with elevation of temperature. . . . Reflecting upon these facts, we see that it is possible to arrange the colours in order, and this I have done as follows:—



"From the foregoing observations we learn (1) that metachromatism arises from increased absorption of light, with elevation of temperature, the more refrangible increment increasing at a greater rate than the less refrangible; (2) that the only necessary concomitant is alteration of atomic potentiality; a change from the violet towards the red end of the metachromatic scale signifying atomic recession (pores expanding), and a change from the red towards the violet, atomic approach (pores contracting)."

(4.) In my work "Pyrology," above referred to, I have shown, both literally and graphically, how a solution of gold in phosphoric acid passes, in cooling, through all the prismatic colours from yellowish orange to bluish violet, and yet Mr. Ackroyd tells us he was the first "to see, at an early stage of study, that nearly all the changes take place in the order of the spectrum colours." (!)

(5.) I fear Mr. Ackroyd will find few scientific men, now-a-days, willing to confirm or allow his extraordinary assertion that "vibratory motion has little or nothing to do with the increased absorption of light by hot bodies," or that "black" is "a colour," or that "brown" is a "spectrum (prismatic) colour."

Stahl is evidently, though unadmittedly, cited by Mr. A. at second-hand, but I should feel obliged by information as to what part of his works "connects colour change with the varying amounts of phlogiston a body contains when heated." The observations of Stahl, with reference to the colours of heated bodies, seem to have been confined to iridescence ("evanescentes colores varia circa capellam formet qui ultimo iridis speciem præbent," &c.—"Fundamenta Chymiae," vol. i., p. 162), and to the change of colour metals experience in alloys ("Per fusionem variae mixturæ metallicæ formantur, et interdum quidem pro certi coloris gradu obtinendo," &c.—*Ibid.*, vol. iii., p. 187). But has Mr. A. neglected to cite, in his historical account, the observations of Boyle, a much greater man than "Stahl and followers" on this subject:—"Minerals also, by the action of the fire, may be brought to afford colours very different from their own," &c. (Boyle's Works, vol. ii., p. 72), or Bacon—"Metals give orient and fine colours in dissolutions" &c. ("Sylva Sylvarum," Century III., p. 75), merely because they were Englishmen, or because he is ignorant of their writings with reference to this matter?

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 6, August 7, 1876.

Experimental Critique on Glycæmia.—M. Claude Bernard.—The author shows that the existence of saccharine matter in the blood is not an accidental fact dependent upon alimentation, but constitutes a constant and permanent physiological phenomenon.

Observations of M. Thenard with reference to the above Communication.—The author maintains the existence of a special affinity, named by M. Chevreul capillary affinity.

Alteration of Urine.—M. L. Pasteur.—A continuation of the discussion on abiogenesis.

Reply to the Last Communication of M. Hirn.—M. A. Leduc.—The author maintains that M. Hirn's researches lead merely to condemn the system of emission as an explanation of the movements of the radiometer of Mr. Crookes.

On Intensity Radiometers.—M. W. de Fonvielle.—Up to the present time the radiometers presented to the Academy differ merely as to the colour or the nature of the two contiguous faces of the discs. However, the dissymmetry of action necessary for rotation may be equally obtained by giving to the instrument a play of perfectly similar discs, the two faces of which may be of the same substance and the same colour; but in this case the discs must be of a helicoid form, whether convex or concave, or merely inclined to the axis of rotation; in a word, the dissymmetry of material or of colour must be replaced by dissymmetry of form. We may imitate the arrangement of the feather-mills, which we have seen at the toy dealers; that of cup anemometers; that of helices set in action by an aerial current; or that of orreries which are readily caused to turn by the electric currents of a Holtz machine. The axle itself does not require to remain vertical if—whilst giving it a horizontal or inclined position—care be taken not to create an exaggerated friction, for the radiometer will turn under the influence of the motor ray if the passive resistances do not exceed the fraction of the total impulsion which produces the rotation in the system adopted. Whatever may be the system adopted all the discs will collect a motor effort, forming an assignable fraction of the total impulsion, and the dynamic formulæ by means of which this element will be determined will be independent of any hypothesis as to the cause of the movement. These calculations will be closely analogous with those to which turbines and windmills have given scope. They cannot be executed with radiometers moving in virtue of the different colour of their discs. The author proposes to give to such apparatus the name of radiometers of intensity.

Determination of the Carbonic Acid contained in Waters (Waters of Irrigation, Drainage, Springs, Rivers, &c.).—M. A. Houzeau.—The method proposed consists in disengaging successively, in a gaseous state, the free and the combined carbonic acid, absorbing it in 5 c.c. of standard solution of soda containing $\frac{1}{100}$ th part of oxide of zinc. The carbonic acid is then determined by a method which the author has previously published (*Annales de Chimie et de Physique*). The apparatus is composed of a flat-bottomed bottle, holding 750 c.c., and closed by a stopper which gives passage to two tubes. One of these, bent into the shape of an S, serves for the introduction of the sulphuric acid destined to liberate the combined carbonic acid after that which is free has been expelled by prolonged boiling. The other tube serves to conduct the carbonic acid gas into a flask, of the capacity of 210 c.c., where it meets with a portion of the standard soda solution, the remainder being in a Will's tube connected with the flask by a caoutchouc stopper. When all the carbonic acid has been disengaged by boiling the water for a sufficient length of time, which takes place in ordinary cases when about 170 c.c. of water have been condensed in the flask containing the standard soda, the alkaline contents of this flask and of the Will-tube are poured into a test-glass on a foot, having a mark at 200 c.c., a neutral solution of chloride of barium is added in excess, and the liquid is made up to 200 c.c. with the washing-waters. The carbonate of baryta settles so rapidly that after it has stood for a few minutes 50 c.c. may be taken from the clear part of the liquid and its value determined with an acid representing exactly 2.0 of CO_2 per c.c. The difference between the strength of the soda solution *before* and *after* the absorption of the carbonic acid gas shows the volume of the standard acid corresponding to the carbonated

soda; this volume, multiplied by 2, gives the weight of the carbonic acid. The author generally operates on $\frac{1}{4}$ litre of water.

New Process for the Qualitative Detection and the Determination of Potassa.—M. Ad. Carnot.—Inserted in full.

Different Rotatory Powers of Cane-Sugar According to the Method used for their Measurement.—M. L. Calderon.—The author finds a mean difference of 6.3° , according as he employs the process of Biot, or the monochromatic flame according to Jellet and Cornu.

Process for the Determination of Hydrocarbons, and in Particular the Fire-damp of Coal Mines.—M. J. Coquillion.—The author makes use of a wire of palladium heated to redness by the battery. The results enable him to estimate with a certain amount of accuracy the amount of fire-damp present in a given atmosphere.

Use of Chloride of Calcium for Watering Roads, &c.—M. Cousté.—The author has experimented with this process as early as 1854.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process of removing phosphorus from iron ores, and refining slag or scoria. G. Velge, Liège, Belgium. May 26, 1875.—No. 1924.—This invention consists in mixing with the phosphorus ores, or the slag or scoria, a quantity of alkaline bases or salts. This mixture being brought to a red-heat, a phosphate is formed, soluble in water or in water slightly acidulated, and the phosphorus may be separated from the iron by washing.

Improvements in the preparation of insulating compounds for coating electric telegraph wires, and other purposes. F. Field, Upper Marsh, Lambeth, Surrey, and R. Talling, Lostwithiel, Cornwall. May 27, 1875.—No. 1938.—This invention relates to insulating compounds prepared by the mixture of ozokerit, or the residue obtained from the distillation thereof with india-rubber, gutta-percha, and other insulating materials, as described in Matthiessen's Specification, No. 3778, of 1869. According to the present invention, instead of incorporating the ingredients by the application of heat, as described in the said Specification, whereby the resulting compound is rendered brittle, the ingredients are incorporated either by dissolving them by means of solvents, such as coal-tar naphtha, and then mixing them together, or by masticating them together by any known mechanical means.

Improvements in the treatment of alunite, or of natural products containing the same, so as to obtain aluminous compounds therefrom. J. H. Johnson, Lincoln's Inn Fields, Middlesex. (A communication from La Société Financière de Paris, Paris.) May 27, 1875.—No. 1946.—The essential features of this invention consist in the treatment of what is known as alunite, or of minerals containing alunite, so as to obtain potassic alum therefrom, which is effected by the employment of sulphuric acid, chloride of potassium, and alunite, or of minerals containing alunite, at an elevated temperature, in order that the chloride of potassium may be converted into sulphate of potash, and potassic alum be obtained from the result of calcination.

Improvements in the treatment of the excreta of towns. J. J. Coleman, F.C.S., Glasgow, Lanark, N.B. May 28, 1875.—No. 1954.—The feature of novelty which constitutes this invention is treating the excreta by mineral oil works' spent shale in the manner set forth.

Improvements in the treatment of ferric, and aluminous and ferric matters, for the purpose of obtaining useful substances therefrom. P. and F. M. Spence, Newton Heath, Manchester, Lancashire. May 28, 1875.—No. 1961.—This invention relates to the manufacture of ferric, and aluminous and ferric compounds, consisting of sulphate of iron and sulphate of alumina and iron.

ERRATUM.—A transposition occurs on page 73, line 20 from top. For "wool from grease" read "grease from wool."

NOTICE.

THE STUDENTS' NUMBER of the CHEMICAL NEWS will be published on Friday next, September 15th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the education, who have not yet forwarded the necessary information to our Office for publication in that Number, will confer a favour by sending it with the least possible delay.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 877.

UNIVERSITIES AND COLLEGES.

UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this examination is £2.

The Examination will be held on Monday, January 8th, 1877. It is conducted by means of Printed Papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *visa voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—1. Latin. 2. Any two of the following Languages:—Greek, French, and German. 3. The English Language, English History, and Modern Geography. 4. Mathematics. 5. Natural Philosophy. 6. Chemistry.

The Papers in Latin and Greek will contain passages to be translated into English, with questions in Grammar and in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected. A separate paper will be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

The papers in French and German will contain passages for translation into English, and questions in Grammar, limited to the Accidence.

The Latin subjects for 1877 and 1878 are—

For January 1877:—*Virgil*, Georgics, Book IV., and *Æneid*, Book IV.

For June 1877:—*Horace*, Odes, Books III. and IV.

For January 1878:—*Liuy*, Book II.

For June 1878:—*Ovid*, *Ætistolæ ex Ponto*, Book II.

Special stress is laid on accuracy in the answers to the questions in Latin Grammar.

The Greek subjects for 1877 and 1878 are—

For January 1877:—*Xenophon*, *Hellenica*, Book I.

For June 1877:—*Homer*, *Odyssey*, Book XII.

For January 1878:—*Homer*, *Iliad*, Book X.

For June 1878:—*Xenophon*, *Hellenica*, Book II.

Candidates may substitute German for Greek.

The Questions in Natural Philosophy are of a strictly elementary character; they include Mechanics, Hydrostatics, Hydraulics, Pneumatics, Optics, and Heat.

The Examination in Chemistry is—Chemistry of the Non-Metallic Elements; including their compounds—their chief physical and chemical characters—their preparation—and their characteristic tests.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners has been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination possess sufficient merit, the first among such Candidates will receive an Exhibition of thirty pounds per annum for the next two years; the second among such Candidates will receive an Exhibition of twenty pounds per annum for the next two years; and the third will receive an Exhibition of fifteen pounds per annum for the next two years; such exhibitions are payable in quarterly instalments,

provided that on receiving each instalment the Exhibitioner declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within three academical years* from the time of his passing the Matriculation Examination.

Under the same circumstances, the fourth among such Candidates will receive a prize to the value of ten pounds in books, philosophical instruments, or money; and the fifth and sixth will each receive a prize to the value of five pounds in books, philosophical instruments, or money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has attained the age of eighteen years.

Several important changes have been made in the regulations relating to the Degrees in Science. These revised regulations relating to the First B.Sc. Examination will come into force at the Examination in July, 1877. Candidates presenting themselves at the Second B.Sc. Examination in October, 1877, will be allowed an option between the old and the revised regulations.

FIRST B.SC. EXAMINATION.

The First B.Sc. Examination will commence on the third Monday in July, 1877.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this Examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The Examination embraces the following subjects:—Pure and Mixed Mathematics, Inorganic Chemistry, Experimental Physics, and General Biology.

In place of the superficial acquaintance with both Zoology and Botany, formerly required at the first B.Sc. examination, there will be a single examination (written and practical) in General Biology, in which a more thorough knowledge will be required of the simplest forms and elementary phenomena of Animal and Vegetable Life, such as is now made the basis of the teaching of some of the most distinguished professors in each department. Candidates will therefore be examined in the following subjects:—

Structure, functions, and life-history of simple Unicellular Plants, such as *Torula* and *Protococcus*, as types of Vegetable Life.

Structure, functions, and life-history of *Penicillium*, *Mucor*, or some other simple Fungus.

Structure, functions, and life-history of *Chara* or *Nitella*. Morphology, histology, and history of the reproduction of a Fern.

Morphology and histology of a Flowering plant; structure of a flower; homologies of leaves and floral elements; histology of ordinary vegetable tissues, such as epidermis, parenchyma, fibro-vascular tissue, and their arrangement in the stem, branches, and leaves.

Growth of a Flowering plant; formation of wood and bark; nature of cambium.

Reproduction of a Flowering plant; structure of ovule; methods of fertilisation; development of ovule into seed.

* By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of a higher grade in the following year; which period may be either more or less than a Calendar year. Thus the interval between the First Examinations in Arts, Science, and Medicine, and the Second Examinations of the next year in those Faculties respectively, is about sixteen months, whilst the interval between the Second B.A. Examination and the M.A. Examination of the next year, or between the Second B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

General principles of Vegetable Nutrition; food of plants; action of green parts of plants; nature and flow of sap.

Structure, functions, and life-history of the following Animals, as types of some of the chief divisions of the Animal Kingdom:—*Amaba*, *Vorticella*, *Hydra*, Earth-worm, Mussel, Snail, Lobster or Crayfish, Frog.

General histology of chief Animal tissues:—Blood; pavement, columnar, ciliated, and glandular epithelium; connective tissue; cartilage; bone; muscle; nerve-fibres and nerve-cells.

General physiology of Circulation, Respiration, and Digestion in the Frog, together with the fundamental properties of muscle, nerve, and the spinal cord.

Reproduction of Frog, and chief phases in life of tadpole.

Thus the student who may be intending to devote himself specially to Physical or Chemical Science will be brought to apprehend the general conceptions common to the two great Organic Kingdoms, without being required to master the specialities of either. And the student who intends to present himself at the second B.Sc. examination in either Physiology, Zoology, or Botany, or all combined, will have laid the best foundation for those special studies in the study of General Biology.

Examination for Honours.

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Pure and Mixed Mathematics at the First B.A. Examination, in which case he will not be admissible to the Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the first B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Chemistry will be examined in Inorganic Chemistry, treated more fully than in the Pass Examination. In addition, they shall be examined practically in Simple Qualitative and Quantitative Analysis. This Examination, which will consist of six hours' examination by printed papers and of six hours' practical work, will take place on Thursday and Friday in the same week with the Examination for Honours in Mathematics, commencing on each day at 10 a.m.

In the Examination for Honours, the Candidate, not being more than 22 years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics, will receive an Exhibition of £40 per annum for the next two years.

SECOND B.Sc. EXAMINATION.

The Second B.Sc. Examination will commence on Monday, October 23rd, 1877.

Candidates for this Examination are required to have passed the First B.Sc. Examination at least one academical year previously.

The Fee for this Examination is £5.

The regulations, which will be commenced on October 23rd, 1877, are framed with the view of allowing the candidate to bring up any three of the following nine subjects:—

1. Pure Mathematics.
2. Mixed Mathematics.
3. Experimental Physics.
4. Chemistry.
5. Botany, including Vegetable Physiology.
6. Zoology.
7. Animal Physiology.
8. Physical Geography and Geology.
9. Logic and Psychology.

It is intended that the examinations in these several subjects should be, as nearly as may be, on the same grade, as to the amount of attainment they require. The experience of the Examiners in Mathematics justifies them in stating that any candidate who has thoroughly mastered the Mathematics of the First B.Sc. Examination, and who has such an aptitude for the study as would lead him to select Pure Mathematics as one of his subjects at the Second, would find no difficulty in mastering the requirements of its programme, by such an amount of study, carried on through an eight months' Academical Session, as would leave him free to bestow the same amount of time and attention on two or even three other subjects. It is understood the amount of proficiency expected in each of the three subjects chosen will be that which the candidate might attain by the steady devotion to it of about one-third of the sessional work of a diligent student.

Examination for Honours.

Any candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the Second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics, (2) Logic and Psychology, (3) Experimental Physics, (4) Chemistry, (5) Botany, (6) Zoology, (7) Physiology, (8) Physical Geography and Geology; provided that he shall have gone through the Pass Examination in the corresponding subject or subjects immediately before. And any Bachelor of Arts who has passed the Second B.Sc. Examination may under the same conditions be examined for Honours in one or more of the above mentioned subjects, unless he have previously obtained a Scholarship at the Second B.A. Examination in either of the first two of those subjects, in which case he shall not be admissible to the Examination for Honours in that subject.

The examination for Honours in Chemistry will take place on Monday and Tuesday in the week following the examination for Honours in Mathematics; on Monday by printed papers (chiefly on Organic Chemistry), and on Tuesday by practical exercises in Simple Qualitative and Quantitative Analysis.

The candidate, being not more than 23 years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

DOCTOR OF SCIENCE.

The examination for the Degree of Doctor of Science takes place annually within the first twenty-one days of June, and the examination in each branch occupies four days.

No candidate is admitted to the examination for the Degree of D.Sc. until after the expiration of two Academical Years from the time of his obtaining the Degree of B.Sc. in this University, unless he shall have passed the Second B.Sc. Examination in the First Division at least two Academical Years subsequently to having passed the First B.Sc. Examination, in which case he shall be admitted to the examination for the Degree of Doctor in Science at the expiration of one Academical Year from the time of obtaining his B.Sc. Degree.

GILCHRIST SCHOLARSHIPS.

1. A Scholarship of the value of Fifty Pounds per annum, and tenable for three years, is annually awarded to the highest among those Candidates at the June Matriculation Examination who have been approved by the Principal of University Hall as fit to be received into that Institution with a view to the prosecution of their studies in University College for Graduation in one of the four Faculties of the University of London; provided that such Candidate pass either in the Honours List or in the First Division.—Particulars may be obtained on application to the Principal of University Hall, Gordon Square, W.C.

2. A similar Scholarship is annually awarded to the Candidate from the Royal Medical College, Epsom, who at the June Matriculation Examination stands highest among the Candidates approved by the Head Master of that Institution, and who passes either in the Honours List or in the First Division; on condition of his prosecuting his studies during the tenure of his Scholarship with a view to Graduation in one of the four Faculties of the University of London.—Particulars may be obtained on application to the Secretary of the Royal Medical College, 37, Soho Square, W.

3. A similar amount is annually offered to Candidates intending to pursue, at Owens College, Manchester, their studies for Graduation in one of the four Faculties of the University of London; a single Scholarship of Fifty Pounds per annum for three years being awarded to the highest of those Candidates at the June Matriculation Examination who shall have been previously approved by the Principal of Owens College, provided that he pass in the Honours Division; or, in case no Candidate should so pass, two Scholarships, each of Twenty-five Pounds per annum, being awarded to the two Candidates as aforesaid who shall stand highest in the First Division.—Particulars may be obtained on application to the Principal of Owens College, Manchester.

Particulars of the Colonial and Indian Scholarships may be obtained on application to the Secretary of the Gilchrist Educational Trust, University of London, W.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—W. Odling, M.A., F.R.S.

Professor of Mineralogy.—N. S. Maskelyne, M.A., F.R.S.

Demonstrator of Chemistry.—T. H. G. Wyndham, M.A.
Analyst in Health Laboratory.—W. F. Donkin, M.A.

Every Student must reside in one or other of the Colleges or Halls, or in licensed lodgings, for a period of three years, passing at least two examinations in Arts, and one in either Mathematics, Natural Science, Law, Modern History, or Theology, when, if he obtain a first, second, or third class, he can take his B.A. Degree; if he do not gain such honour he has to pass a third examination in *Literis Humanioribus*.

The instruction in Natural Science is carried on at the Museum, where there is practical instruction in Physics, Chemistry, Anatomy, and several other departments of natural science, together with courses of lectures and of practical instruction and work, by the several professors.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

More detailed information may be obtained from the University Calendar; from the professors; from E. Chapman, Esq., M.A., Frewin Hall; and from the Sub-Librarian in the Radcliffe Library or the Museum.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

Jacksonian Professor of Natural History.—J. Dewar, M.A.

Demonstrator.—J. W. Hicks, M.A.

The Student must enter at one of the Colleges, or as a Non-collegiate Student, and keep terms for three years by residence in the University. He must pass the previous examination in Classics and Mathematics, which may be done in the first or second term of residence, or, through the Oxford and Cambridge Schools Examination Board, before commencing residence. He may then proceed to take a Degree in Arts, either continuing mathematical and classical study, and passing the ordinary examinations for B.A., or going out in one of the Honour Triposes.

The scholarships, ranging in value from £20 to £80 a year, are chiefly given for mathematical and classical proficiency. Scholarships are given for Natural Science in Trinity, St. John's, St. Peter's, Clare, Christ's, Sidney,

Pembroke, Caius, and Downing Colleges; the examinations being at Easter, and in June and October.

The Chemical Laboratory of the University is open daily for the use of the Students. The Demonstrator attends daily to give instructions.

Non-collegiate Students are allowed to attend certain of the College Lectures and all the Professors' Lectures, and have the same University status and privileges as the other Students. They are under the superintendence of the Rev. R. B. Somerset, Orford House, Cambridge, from whom further information may be obtained.

The following are the Lectures on Chemistry for the ensuing Academic Year:—

MICHAELMAS TERM, 1876.

General Course, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Oct. 13.

Spectroscopic Analysis, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 1 p.m. Begin Oct. 16.

Qualitative Analysis, by the Professor and the Demonstrator of Chemistry. Daily. Begin Oct. 11.

Physical Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Oct. 17.

The Principles of Qualitative Analysis, by Mr. Main, at St. John's College, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Oct. 19.

Volumetric Analysis, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Oct. 18.

LENT TERM, 1877.

General Course continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Jan. 24.

Analysis, by the Professor or Demonstrator of Chemistry. Daily. Begin Jan. 24.

Organic Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Jan. 23.

Elementary Course, by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Feb. 1.

Non-metallic Elements, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Feb. 2.

EASTER TERM, 1877.

Some Special Department, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin April 18.

Analysis, by the Professor or Demonstrator of Chemistry. Daily. Begin April 16.

Laboratory Instruction in Chemical Research, by the Jacksonian Professor. Times to be announced hereafter. Elementary Inorganic Chemistry, by the Demonstrator of Chemistry, on Tuesdays, Thursdays, and Saturdays, at 3 p.m.

Elementary Course concluded, by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin April 17.

Organic Analysis and Elementary Organic Chemistry, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin April 18.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE [OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,

AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant is to promote instruction Science,

especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes were awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Mineral Chemistry, commencing October 2, 1876. A Course of Thirty Lectures on Organic Chemistry, commencing January 15, 1877. Fees—Lectures on Mineral Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Monday, October 2, 1876. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

Physics, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures.* The Course will commence on October 4, 1875. Fee for Lectures and Laboratory work, £10.

Metallurgy, by Dr. Percy, F.R.S. The Course will consist of about Fifty Lectures, commencing on October 10, 1875.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the institution. Those for the ensuing Session include Chemistry, Mineralogy, and Applied Mechanics.

EXHIBITIONS, SCHOLARSHIPS, AND PRIZES.

There are various Exhibitions, Scholarships, and free admissions attached to the School. They are as follows:—

* A detailed account of the Laboratory Instruction in Physics will be found in the Students' Number of the CHEMICAL NEWS for 1875 (No. 824).

Royal Exhibitions.

There are nine Royal Exhibitions to the Royal School of Mines, Jermyn Street, of the value of £50 per annum, entitling the holders to free admission to all the lectures and the chemical and metallurgical laboratories at the Royal School of Mines, to be held from year to year for three years, on the condition that the holder attends the courses regularly during those years, complies with all the rules laid down for his guidance, and passes the examinations required for the associateship of the school.

Free Admissions.

A free admission, conferring the privilege of attending all Lectures and Examinations without the payment of fees, is offered to any person who obtains a Queen's Gold Medal at the annual May Examinations of the Science and Art Department.

Royal Scholarships.

Two Scholarships, of fifteen pounds each, are given to the Students who shall stand highest on the list of those who have passed their Examinations for the first year; and a Scholarship of twenty-five pounds to that pupil who has gained the greatest number of marks in the examinations of the first two years.

KING'S COLLEGE.

(DEPARTMENT OF ENGINEERING AND APPLIED SCIENCE.)

Professor of Chemistry.—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

Assistant Demonstrator.—J. M. Thompson, F.C.S.

I. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term, or £8 8s. for the year.

II. For Students who have any Examination in prospect, or who require general guidance in their Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evenings, from 6.30 till 7.30. Fee, £1 1s. for the Course.

PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

II. May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 till 12.15 a.m. Fee, £5 5s. for the Course.

III. Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

LABORATORY OF ANALYTICAL AND EXPERIMENTAL
CHEMISTRY.

For the study of all branches of Practical Chemistry.

Each Student works independently in the Laboratory, which is open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry—One month, £4 4s.; three months, £10 10s.; six months, £18 18s.; nine months, £26 5s.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Assistant Professor.—Charles Graham, D.Sc.

A. GENERAL COURSE.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

The instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry commences in the second week in February, and occupies five Lectures weekly till about the end of March.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

B.—ANALYTICAL AND PRACTICAL CHEMISTRY.

I. Birkbeck Laboratory.

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 2nd of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees, for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

II. Summer Courses.

1. *Elementary Course*.—About forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

2. *Senior Course*.—This Course consists of twenty Lessons of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

Fees, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

UNIVERSITY COLLEGE, BRISTOL.

Professor of Chemistry.—E. A. Letts, Ph.D., F.R.S.E.

Assistant Lecturer.—W. W. J. Nicol, M.A.

Scholarships.

The following Scholarships will be offered in October:—

One Chemical Scholarship of the value of £25, tenable for one year.

Subjects of examination:—1st. A qualifying examination in the subjects required for the General Scholarships. 2nd. A Special Competitive Examination in Chemistry, both written and practical.

Three General Scholarships of the value of £15 each, tenable for one year.

The successful candidates for these General Scholarships will be required to attend at least three subjects of Lectures and Classes at the College.

The Examinations will begin on Tuesday, the 3rd of October, at 10 a.m., and will be held at the College, Park Row, Bristol. The minimum age for Candidates is fixed at sixteen.

The following will be the subjects of Examination:—English Grammar and Composition, and Elementary Mathematics. In addition to these, each Candidate will be expected to offer at least one subject from the following list, but will not be allowed to offer more than three:—(1) Latin; (2) French; (3) German; (4) some period of English History; (5) some period of English Literature; (6) Chemistry; or (7) some other branch of Natural Science; (8) some portion of higher Mathematics; (9) Political Economy; (10) Physical and Political Geography of Europe.

The First Session will be divided into Three Terms. The First Term will commence on the 10th of October and end on the 20th of December, 1876. The Second Term will commence on the 10th of January and end on the 28th of March, 1877. The Third Term will commence on the 10th of April and end in July, 1877.

Inorganic Chemistry.

This Course will consist of Three Lectures a week, and will be continued during the First and Second Terms. They will be devoted to a consideration of the Theory of Chemistry, Chemical Physics and Descriptive Inorganic Chemistry. In treating of the various substances under the latter heading, special attention will be given to their applications in the arts and manufactures. Fee, £3 3s.

Organic Chemistry.

The Course will consist of about forty Lectures, devoted to a consideration of the Carbon Compounds, and to a general examination of the leading groups of Organic Substances. Special attention will be given to the applications of Organic Chemistry to the Arts and Manufactures, more particularly to Dyeing and the Manufacture of Sugar, Soap, Coal Tar products, &c. Fee, £1 1s.

Laboratory Instruction.

The College Laboratory will be open daily at 10 a.m. Instruction will be given in the Laboratory in all branches of Practical Chemistry, including Qualitative and Quantitative Inorganic and Organic Analysis, the preparation of Chemical Products, and Inorganic and Organic Research, special facilities being afforded to those who desire to study Practical Chemistry, as applied to the different processes employed in the Arts and Manufactures. Each Student will be required to provide, at his own expense, a set of ordinary apparatus at a cost of about 21s. The cost of material for original research must also be paid by the student requiring it.

Fees—per Session:—Students working 6 days per week, £18 18s.; 3 days per week, £10 10s. Per Term:—Students working 6 days per week, £7 7s.; 3 days per

week, £4 4s. Per Month :—Students working 6 week, £3 3s.; 3 days per week, £2 2s.

Evening Classes.

A Course devoted to Chemical Technology. Fee, 10s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor of Chemistry—A. H. Church, M.A. Oxon.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given :—

- 36 Lectures on Inorganic Chemistry.
- 36 Lectures on Organic Chemistry.
- 36 Lectures on Agricultural Chemistry.
- 36 Laboratory Lessons in Chemical Manipulation.
- 36 Laboratory Lessons in Qualitative Analysis.
- 36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

Professor of Chemistry.—T. E. Thorpe, Ph.D., F.R.S.E., F.C.S.

Lecture Courses.

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 10 a.m., from October to the end of March. Fee, 1s. 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., from October to March. Fee, 6s. 6d.

Laboratory Courses.

Professor T. E. Thorpe, Ph.D., F.R.S.E.

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session—Students working six days per week, £17 17s.; four, £13 13s.; three, £11 11s.; two, £8 8s.; one, £4 4s.

Special fees for shorter periods—For six months, six days per week, £13 13s.; five, £11 11s.; four, £9 9s.; three, £7 7s.; two, £5 5s.; one month, £3 3s.

Class in Practical Chemistry, Saturday mornings, from 9 to 12, from October to March. Fee, £1 11s. 6d.

Practical Chemistry for Medical Students.—On Monday and Wednesday, from 9 to 11 a.m., from May to the end of July.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Chemistry.—*Professor*—A. Freire-Marreco, M.A. *Demonstrator*—J. T. Dunn, Assoc. Phys. Science.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees*.—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the

Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the 2nd October, 1876.

Evening Classes.—*Professor* A. Freire-Marreco, M.A. Twelve Lectures on the Principles of Modern Chemistry, and its relation to other Molecular Forces. Mondays, at 7.45, commencing October 30, 1876.

OWENS COLLEGE, MANCHESTER.

Professor and Director of the Chemical Laboratories.—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor of Organic Chemistry.—C. Schorlemmer, F.R.S.

Demonstrators and Assistant Lecturers.—Mr. W. C. Williams, F.C.S., and Mr. M. M. Pattison Muir, F.R.S.E. *Hon. Demonstrators*.—Mr. Thomas Carnelley, B.Sc., and Mr. Oswald Wilkinson.

Lecture Courses.

Systematic Chemistry.—*Junior Class*.—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (a) of Experimental Lectures and (b) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—*Professor* C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

Technological Chemistry.—Monday and Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows :—

1. Twenty Lectures on Water and Air and the Chemistry of the Alkali Manufacture, by *Professor Roscoe*.

2. Twenty Lectures on the Chemistry of Colouring Matter, Dyeing, and Calico Printing, by *Professor Schorlemmer*.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Chemical Philosophy.—*Professor* C. Schorlemmer, F.R.S. Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,
STEPHEN'S GREEN, DUBLIN.

Professor of Practical and Theoretical Chemistry.—R. Galloway, F.C.S.

Professor of Experimental Physics.—W. F. Barrett, F.R.S.E., F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week-day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education, including Laboratory Instruction, tenable for three years; three become vacant each year.

A Diploma of Associate of the College is granted at the end of the three years' course.

The Session commences on Monday, October 2nd.

ANDERSONIAN UNIVERSITY, GLASGOW.
DEPARTMENT OF SCIENTIFIC CHEMISTRY.

Professor of Chemistry.—W. Dittmar, F.R.S.E., &c.
Young Professor of Technical Chemistry.—Dr. E. J. Mills, F.R.S.

CHEMICAL LECTURES, CLASSES, AND
LABORATORY INSTRUCTION.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES, 44, Berners Street, W.—Prof. E. V. Gardner, F.A.S., M.S.A. The Laboratory is open morning and evening throughout the year.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.—Mr. G. Chaloner, F.C.S. Tuesdays, 8.30 to 9.30 p.m. Manipulation and Analysis, Saturdays, 7 to 10 p.m.

CITY OF LONDON COLLEGE, 52, Leadenhall Street, E.C.—Chemical Lecturer, Thos. Eltoft, F.C.S. Mondays, 7.30 to 8.30 p.m. Fee 6s. per term, or 15s. per session.

NORTH LONDON SCHOOL OF CHEMISTRY AND PHARMACY, 54, Kentish Town Road, N.W.—Mr. J. C. Braithwaite. The classes meet daily at 8 p.m. Fee 10s. 6d. per month. The Laboratory is open for Instruction in Practical Chemistry.

ROYAL POLYTECHNIC COLLEGE.—Chemical Lecturer, Mr. Thomas Eltoft, F.C.S. The Annual Course consists of three terms, each averaging ten Experimental Lectures. 7.30 p.m. Fee 6s. per term, Session 15s. Practical Chemistry, T. Eltoft, F.C.S.; fee, 12s. per term.

ROYAL VETERINARY COLLEGE, Camden Town.—Professor of Chemistry, Mr. R. V. Tuson.

CHEMICAL LECTURES AT LONDON HOSPITALS.

Chemical Schools and Colleges.	WINTER SESSION.			SUMMER SESSION.		
	Lecturers on Chemistry.	Days and Hours.	Fee. One Course.	Lecturers on Chemistry.	Days and Hours.	Fee. One Course.
St. Bartholomew's Hosp. and College	Dr. Russell, F.R.S.	M. W. F., 9	£ s. 5 5 7 7	Dr. Russell	M. Tu. F., 11 to 1	£ s. 2 2 3 3
Charing Cross Hospital and College	Mr. Heaton	M. W. F., 11	5 5 7 7	Mr. Heaton	M. F.	2 2
St. George's Hospital	Dr. Noad, F.R.S.	Tu. Th. S., 11½	6 6 8 8	Dr. Noad	Da. ly, 10	4 4
Guy's Hospital	Dr. Debus, F.R.S., and Dr. Stevenson	Tu. Th. S., 11	5 5	Dr. Debus	M. W. F., 10 to 1	4 4
King's College and Hosp.	Mr. Bloxam, F.R.S., and Mr. Hartley	Th. S., 10½	7 7 10 10	Mr. Bloxam and Mr. Hartley	M. W. F., 10½	5 5 8 8
London Hospital	Dr. Tidy	M. Tu. W. Th., 11	7 7 7 7	Dr. Tidy	M. Th. S., 9	2 2 3 3
St. Mary's Hospital	Dr. Wright	M. W. Th., 4	4 4 6 6	Dr. Wright	Tu. F. S.	3 3
Middlesex Hospital	Dr. Greenhow	M. W. Fr., 9	6 6 8 8	Mr. W. Foster	M. W. F., 3	3 3
St. Thomas's Hospital	Dr. Bernays	Tu. Th. F., 12	7 7 9 9	Dr. Bernays	Tu. Th. S., 10	4 4 7 7
School	Dr. Williamson, F.R.S., and Dr. Graham	Daily (ex. S.), 11	7 7 9 9	Dr. Williamson & Dr. Graham	Daily (ex. S.), 11	4 4
University Coll. & Hosp.	Dr. Dupré, F.R.S.	W. Th. F., 3	5 5	Dr. A. Dupré	M. W. F., 10	3 3
Westminster Hospital						

SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, Bloomsbury Square.—The school opens on Monday, the 2nd of October. Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, at 9 a.m. The Laboratories for Practical Instruction in Chemistry as applied to Pharmacy, &c., under the direction of Prof. Atfield, will be open daily at 10 a.m. throughout the Session.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, Kennington Road.—Dr. John Muter, F.C.S. Daily, at 10 a.m. The Laboratory is open daily for Practical Instruction.

BIRMINGHAM.—MIDLAND INSTITUTE.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.; Friday, at 7; and Saturday, at 3.

BIRMINGHAM.—**QUEEN'S COLLEGE.**—A. C. Bruce, M.A. Tuesday, Thursday, and Friday, at 12.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.—J. Campbell Brown, D.Sc. Lond., F.C.S.

SCHOOL OF TECHNICAL CHEMISTRY, 7 and 9, Hackin's Hey, Liverpool.—Mr. A. Norman Tate. 9.30 a.m. Evening Laboratory Instruction.

COLLEGE OF CHEMISTRY, LIVERPOOL—Mr. Martin Murphy, F.C.S. The Laboratories are open from 10 a.m. to 5 p.m. daily.

LEEDS MECHANICS' INSTITUTION.—Mr. G. Ward, F.C.S. **MANCHESTER GRAMMAR SCHOOL.**—Mr. Francis Jones, F.C.S., F.R.S.E.

MANCHESTER MECHANICS' INSTITUTION.—Mr. M. A. Watts, M.A. Friday, 7.15 p.m.

QUEENWOOD COLLEGE, near Stockbridge, Hants.—Mr. E. W. Prevost, Ph.D., F.C.S., F.R.S.E.

SHEFFIELD BOROUGH ANALYSTS' LABORATORY, 1 and 3, Surrey Street.—Mr. A. H. Allen, F.C.S. Day and Evening Classes.

SHEFFIELD SCHOOL OF MEDICINE.—Mr. A. H. Allen, F.C.S.

UNIVERSITY OF ABERDEEN.—Prof. J. S. Brazier. **ABERDEEN SCHOOL OF SCIENCE AND ART MECHANICS' INSTITUTION.**—Mr. Thomas Jamieson, F.C.S.

UNIVERSITY OF EDINBURGH.—Prof. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.—Dr. Stevenson Macadam, F.R.S.E., and Mr. Falconer King.

GLASGOW UNIVERSITY.—Prof. J. Ferguson.

GLASGOW MECHANICS' INSTITUTION.—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

SCHOOL OF CHEMISTRY, 138, Bath Street, Glasgow.—Dr. Wallace, Mr. Tatlock, and Dr. Clark. Day and Evening Classes.

CHEMICAL LABORATORY, 144, West Regent Street, Glasgow.—Dr. Milne. Day and Evening Classes.

ANALYTICAL LABORATORY, 88, Hope Street, Glasgow.—Dr. A. T. Machattie, F.C.S. Day and Evening Classes.

QUEEN'S COLLEGE, BELFAST.—Dr. Andrews, F.R.S., &c. **QUEEN'S COLLEGE, CORK.**—Dr. Maxwell Simpson.

QUEEN'S COLLEGE, GALWAY.—Dr. T. H. Rowney.

ROYAL COLLEGE OF SURGEONS IN IRELAND.—Dr. C. A. Cameron.

UNIVERSITY OF DUBLIN.—Dr. J. Emerson Reynolds. **DUBLIN, CARMICHAEL SCHOOL.**—Dr. C. R. C. Tichborne.

REPORT ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 87.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

WHEN Deacon's process was first made known its industrial practicability was strongly doubted. The principal difficulties were considered to depend on the regulation of the temperature, the enormous volume of gases to be dealt with, and the considerable consumption of fuel. Since, however, the two former obstacles have been overcome by the inventor in the manner described, the process seems more and more available. In Great Britain at least 13 establishments are already working on the new process, and in Germany 2 (Kunheim and the

Rhenania, the latter experimentally). According to Deacon's statement more than 1000 kilos. of chloride of lime at 35 per cent are obtained from 1500 kilos. of salt, with a consumption of 1000 kilos. small coal. A small portion of the hydrochloric acid gas is lost from causes not as yet fully ascertained, but the portion which passes undecomposed through the apparatus is entirely recovered.

Besides Deacon's process several other proposals have been made for obtaining chlorine, and in some cases without the use of manganese, but they have not been adopted in practice.

Thus Macfarlane* hoped to obtain soda and chlorine simultaneously by passing air over an ignited mixture of copperas and salt. Sulphate of soda and ferrous chloride are formed, which latter is converted into iron oxide and chlorine by the oxygen. The mixture of sulphate of soda and oxide of iron on reduction with coal and lixiviation with water yields sodium hydrate (easily convertible into soda) and iron sulphide which is reconverted into copperas on exposure to the air. Clemm† endeavoured to use chloride of magnesium for the preparation of chlorine; he mixed the magnesium chloride with manganese and decomposed it by a current of superheated steam.

Chloride of lime, the only form in which free chlorine is found in the market, has latterly been the subject of a number of published papers, which have not led to any material change in the manner of its preparation. The causes of its spontaneous decomposition, sometimes attended with explosions, and formerly not infrequent, have been investigated. To avoid such misfortunes it is recommended not to saturate the lime when too hot, and not to carry the process to the uttermost attainable point, and also not to pack it in barrels when still too recent and too moist. The gas which occasions the explosion of the chloride of lime casks has been found to be oxygen, and on such spontaneous decompositions the mass of the compound is converted into a mixture of chloride and chlorate of calcium. Interesting dissertations of a more scientific character concerning the nature of chloride of lime have been published by Kolb, Riche, Bobierre, Scheurer-Kestner, Tschigianjang, Fricke and Reimer, Crace-Calvert, and Göpner, which unfortunately cannot be reported on in brief, as the results of these researches are in part, at least, contradictory. The final solution of the question as to the constitution of chloride of lime is by no means solved.

(To be continued).

ON THE ELECTROLYSIS OF THE DERIVATIVES OF ANILINE, PHENOL, NAPHTHYLAMINE, AND ANTHRAQUINONE.

By M. F. GOPPELSROEDER.

I HAVE completed my first experiments on electrolytic aniline-black, and I am in a condition to give the numerical results of my analyses, and the rational formula to which they seem to lead. Quite differently from the salts of aniline behave the salts of crystallised toluidine and also the salts of pseudotoluidine. The former furnish at the positive pole a brown matter, soluble in alcohol and dyeing silk and wool a yellowish brown. Pseudotoluidine distinguishes itself from it very plainly, since on electrolysis we obtain at the positive pole a reaction which agrees with that which is obtained by chloride of lime. It forms a violet colour, which is changed by dilute nitric acid or by the solution of permanganate of potash to a red colour. The mixtures of the bases aniline, toluidine, and pseudotoluidine behave differently from the separate bases. Thus an aqueous solution of 1 molecule of hydrochlorate of aniline with 2 molecules of hydrochlorate of toluidine is coloured red at the positive pole. Commercial aniline imperfectly

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

* Macfarlane, *Dingl. Pol. Journ.*, clxxiii., p. 129.

† Clemm, *Dingl. Pol. Journ.*, clxxiii., p. 127.

saturated with sulphuric acid, in an aqueous solution, with an addition of ammonia, gave, at the dehydrogenising pole as a principal product, a red colour, and as a secondary product a violet colour. Methylanilin gives when employed in the form of its salts a violet colour at the positive pole. I have otherwise observed, according to circumstances, other colourations, among them a blue. Diphenylamin gives, if one of its salts is submitted to electrolysis at the positive pole, a blue product soluble in alcohol. Mixtures of diphenylamin and of ditolulamin or of diphenylamin, ditolulamin, and phenyltolulamin such as are employed to produce the blue colours called *diphenylamin blue*, or, according to theory, *triphenylated rosanilin blue*, give, if submitted in the state of salt to a galvanic current, this beautiful blue colour soluble in alcohol. Methyl-diphenylamin which, as Bards has shown, yields, with different oxidising agents a blue or violet colouring matter, undergoes the same transformation in the electrolytic way. Phenol, in an acidulated aqueous solution or in the form of phenate, gives rise at the positive pole to a brown body. The salts of naphthylamin decomposed by the current, in a neutral or acid solution, give rise to naphthylamin violet. Anthraquinon has attracted my attention. I sought first to transform it by electrolysis at a low temperature into alizarin and the latter into purpurin, but without success. I commenced then a new series of experiments, operating at a high temperature. Meeting anew with great difficulties, I obtained, however, a result which encourages me to continue my studies. I observed that on operating with caution a part of the anthraquinon is transformed into alizarin. This transformation takes place on introducing into a very concentrated solution of caustic potash anthraquinon reduced to a very fine powder, passing the galvanic current and heating almost to the melting-point of potash. The mass is coloured at first red and then violet by the formation of alizarate of potassium. But this colouration is rapidly replaced by a new red colouration, which soon changes to a yellowish brown and even to a deep brown, and consequently we obtain a violet product mixed with unchanged anthraquinon and with brown electrolytic products. If we continue to heat it the mass becomes more and more clear and finally white. If at the moment when the last red colouration presents itself we reverse the current the mass again becomes violet, then red and yellowish, because without doubt anthraquinon and even anthracen are formed again. I may say, moreover, in a general manner that if we do not go too far with decompositions, we may by reversing the poles of the battery regenerate at the new negative pole the modified bodies, and reproduce at the new positive pole the transformations that were previously produced at the opposite electrode. In the electrolysis described of the derivatives of aniline, phenol, and naphthylamin, the positive pole plays the principal part. In the electrolysis of anthraquinon it is at the negative pole that the violet colouration commences and remains most intense during the whole of the operation. All the experiments of which I have just spoken depend on the decomposition of water or an alkaline derivative by the current. It is the electrolytic oxygen which acts in dehydrogenising, or in other cases it is the oxyhydriol of the potassium or of the sodium, which is substituted for the hydrogen of the chromogen.

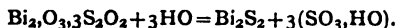
Up to the present time I have turned my attention especially to the principal products, without losing sight of the secondary products, the study of which is necessary to arrive at a clear idea of the metamorphoses which take place. It is also necessary to observe the gaseous products. The action of the current on melted organic bodies, proceeding as we do in mineral chemistry, will present especially great difficulties, whether because heat alone decomposes them, or because the electric conductivity is too weak; but the study of these actions ought not to be neglected. We ought to try also to arrive at the simultaneous decomposition of other bodies added to the electrolyte, to arrive at substitution products of the chro-

mogen or of its electrolytic product. We shall thus arrive at substitutions by alcoholic radicals and by the phenyl series, just as we succeed by the aid of nitric acid or nitrates in producing at the positive pole nitro-derivatives and at the negative pole nitroamido-, amido-, and even azo-derivatives. The chemistry of colouring-matters will find in the researches of which I have spoken, a field so much the more fertile as the oxidations and the dehydrogenisations play the most important part in the production of colours.—*Comptes Rendus*.

ON CERTAIN NEW SALTS OF BISMUTH, AND THEIR EMPLOYMENT IN THE DETECTION OF POTASH.

By A. CARNOT.

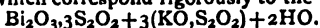
I HAVE succeeded in preparing certain new salts of bismuth, which are distinguished among all the salts of the same metal with mineral acids, by complete solubility in water. These are *double hyposulphites of bismuth and alkalies*. I shall indicate the method of preparation and the properties of these salts, and shall show that they are capable of a very interesting application in analytical chemistry. If into a slightly acid solution of chloride of bismuth we pour a concentrated solution of hyposulphite of soda, the liquid immediately takes a yellow colouration; it remains otherwise perfectly clear, and it even resumes a complete limpidity if it was at first a little dull for want of acid. It may be afterwards mixed with water in any quantity without there being produced any turbidity, provided that we employ a sufficient quantity of hyposulphite (about 3 grms. to 1 of bismuth). This liquid, left to itself, changes gradually, and so much the quicker as it is more concentrated. There is a deposit of sulphide of bismuth and a formation of sulphates, a reaction which is easily explained by the decomposition of hyposulphite of bismuth—



Heat favours this decomposition and produces a deposit of sulphide in small black crystalline grains, which, under the microscope, present a cubic form. We may add any quantity whatsoever of alcohol to the solution which has just been prepared, or pour hyposulphite of soda into an alcoholic solution of chloride of bismuth without obtaining any precipitate. But we must remark that, if alone, the hyposulphite of soda gives immediately a white precipitate in alcohol, where it is almost insoluble. The compound formed, which is a double hyposulphite of bismuth and of soda, is thus distinguished at once both from the ordinary salts of bismuth by its solubility in water and from hyposulphites by its solubility in alcohol. A small quantity of chloride of potassium added to the perfectly clear alcoholic liquid, produces immediately an abundant precipitate of a siskin yellow, which collects easily, especially after some moments agitation. There is not produced, on the contrary, any precipitate in presence of chlorides of sodium, lithium, ammonium, calcium, magnesium, aluminium, iron, manganese, &c.—in a word, all usual metals, which are not precipitated by sulphuretted hydrogen. Only the chlorides of barium and of strontium give white precipitates in an aqueous or alcoholic solution of hyposulphite. The reaction of the salt of potash is therefore quite characteristic. It has seemed to me calculated to furnish a very sensitive and very rapid process for the detection of this base, a detection which is tedious and delicate by the processes at present in use. It succeeds not only with a solution of chlorides but also with a mixture of chlorides and nitrates, and even with nitrates alone, chlorine playing no part in the formation of the precipitate. It is, on the contrary, more or less incomplete in the presence of sulphates, and doubtless cannot be applied directly for the detection of potash in this class of salts. We know, however, that it is the same with the best processes known up to the present time for the separation and the determina-

tion of this base. All require a previous transformation of sulphates.

Double Hyposulphite of Bismuth and Potash.—In view of an application of the potash compounds in analytical chemistry, I have made them the subject of a special study. Here are the principal results:—The yellow precipitate obtained in alcohol is easily soluble in water; its solution is greenish; it is, on the contrary, very insoluble in alcohol. We may then purify it from the salts which saturate it by receiving it at first on a filter, washing with alcohol, then dissolving in a little water, and precipitating anew by alcohol in excess. After one or two similar operations it may be considered as very pure. It may be then dried gently on the filter, and withstands afterwards, without change, a temperature of 100°. It keeps very well when dried, but changes rapidly if moist, notably in contact with the mother liquor, whence it has been precipitated, and which is, moreover, itself readily changeable. In these conditions, it is, at the end of some hours more or less mixed with sulphide of bismuth, which modifies the colour and composition. The neutral solution of the salt in water changes likewise and gradually deposits sulphide. The salt precipitated by alcohol presents a crystalline aspect the more decided as it is formed more slowly. I have been able to obtain it distinctly crystallised on realising by divers methods a gradual mixture of the liquids. The difficulty always rests in the want of stability of the liquor, which ought, however, to remain a very long time in action for the formation of crystals; thus we can scarcely avoid a little sulphide being mixed with the crystals of hyposulphite. The process which has given me the best results consists in making the aqueous solution of the three substances in the required proportions (about 1 part of chloride of potassium and 3 parts of hyposulphite of soda in crystals to 1 part of metallic bismuth transformed into chloride) precipitating with alcohol and filtering to remove the mother-liquor, re-dissolving in water, and adding alcohol to the solution, but without producing any turbidity; then we plunge into it a dialyser, into which we pour concentrated alcohol so as to raise gradually the alcoholic percentage of the hyposulphite solution. There is formed on the sides of the vessel, and principally under the membrane of the dialyser, yellow greenish crystals, very brilliant, presenting the form of prismatic needles, very fine in general, and from 2 to 3 millimetres in length, but attaining sometimes 10 millimetres in length and $\frac{1}{2}$ millimetre in diameter. These crystals keep very well in the air without any alteration. I have made several analyses of the crystallised salt or crystalline precipitate. They have always given me results which correspond rigorously to the formula—



or in hundredths—

Hyposulphurous acid	42.25
Bismuth oxide	34.33
Potassa	20.78
Water	2.64

100.00

It remains for me to indicate in what manner the formation of this salt may be practically utilised for the separation and the determination of potash.

THE CHEMICAL CONSTITUTION OF THE HIGHER ACID HETEROLOGUES OF THE ETHYLIC, GLYCOLIC, AND GLYOXALIC ALCOHOLS,

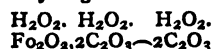
AS VIEWED AND INTERPRETED FROM THE STANDPOINT
OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

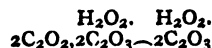
In a paper on the chemical constitution of glycolic alcohol and its heterologues, which I had the honour of reading

at the meeting of the British Association in Edinburgh, some years ago, I drew attention to the existence of two closely-related organic family groups, one of them having for its parent molecule the ethylic and the other the glycolic alcohol. I took also the opportunity of pointing out the natural order of succession, in which the basic and acid members of each group are descended from their respective parent alcohols, and to enlarge on the evident parallelism and intimate chemical relations subsisting between these two series of derivatives. It becomes now requisite for me to add thereto a third family group of molecules, which have for their common progenitor the glyoxalic alcohol. A simple comparison of these three systems, as placed side by side in the annexed scheme, will, I trust, enable the reader to grasp some of the chemical relations just referred to, while it will help to throw a bright and powerful light upon several obscure and disputed points, a full elucidation of which cannot fail to prove of the highest theoretical value and importance.*

Taking it for granted that, within certain limits, the formulæ embodied in the preceding scheme are well calculated to give a correct idea of the internal molecular structure and arrangement of these three sets of derivatives, I shall now, on the basis of these formulæ, proceed to analyse a number of chemical reactions which—from the more or less striking physical and chemical properties of the resulting compounds, as well as the deep mystery in which the majority of these reactions continue to be shrouded—have never ceased to be regarded with special attention and interest. In former papers on this subject (CHEM. NEWS, vol. xxviii., pp. 87 and 103) I have already had occasion to describe the molecular changes, when the higher acid heterologues of the second and third family groups make their appearance amongst the decomposition products of certain bisasic water salts. In particular I occupied myself with tracing the various movements of one of the two basic hydrogen nuclei when the tartronate—



is made by heat to split up into carbonic acid and the glycolate, or when the mesoxalate—



is by the same agent made to resolve itself into carbonic acid and the glyoxalate; and from these results I have been led to conclude that during the conversion of the mesoxalate into the tartronate by means of nascent hydrogen, that element must have expended its reducing energies upon the carbonous acid adjunct in preference to the more highly oxidised oxalic acid principal, a mode of viewing which is strongly supported by the fact that both the oxalate and the glyoxalate can be speedily transformed into the glycolate by means of this powerful reducing agent. It is, noteworthy, however, that on treating the latter compound with oxidising agents the resulting product is not, as might be expected, the glyoxalate, but the so-called glyoxylyte, clearly showing that the two molecules of oxygen, instead of regenerating the carbonous acid adjunct with elimination of two water molecules, prefer to combine directly with the formic acid principal. If now we bring a second pair of oxygen molecules to act upon the latter compound, the resulting product is undoubtedly the oxalate, clearly showing that it is the car-

* The chemical formulæ employed are generally the double of the ordinary formulæ. The notation is simplified by means of symbols representing hydrogen or bicarbon nuclei variously modified by their chemical union with different hydrocarbon and halogen adjuncts. Strokes placed above these symbols indicate the number of substituted bromine molecules in the associated hydrocarbons. The following is a list of the symbols embodied in the formulæ of the text:—(1.) Formyl in the two isomeric modifications, $\text{Fo}_2 = 2\text{C}_1$; H_1 and $2\text{Fo} = 2\text{H}$; 2C_2 (bromformyl, $2\text{Fo} = 2\text{Br}$; 2C_2). (2.) Methyl, $\text{Me}_2 = 2\text{H}_1\text{C}_1$; H_1 . (3.) Ethyl, $\text{Et}_2 = 2\text{H}_1\text{C}_2$; H_2 . (4.) Acetyl in two isomeric modifications, $\text{Ac}_2 = 2\text{H}_1\text{C}_2$; H_2 and $2\text{Ac} = 2\text{H}_2\text{C}_2$; 2C_2 (bromacetyl, $2\text{Ac} = 2\text{H}_2\text{C}_2\text{Br}$; 2C_2 ; dibromacetyl, $2\text{Ac} = 2\text{HC}_2\text{Br}_2$; 2C_2 ; tribromacetyl, $2\text{Ac} = 2\text{C}_2\text{Br}_3$; 2C_2). $\text{H}_2 = 2$; $\text{C}_2 = 12$; $\text{O}_2 = 16$.

SYNOPTICAL ARRANGEMENT OF CHEMICAL FORMULÆ EXPRESSING THE CHEMICAL CONSTITUTION OF THREE CLOSELY-RELATED ORGANIC FAMILY GROUPS.

First Group.	Second Group.	Third Group.
Ethylic alcohol, H_2O_2 , Et_2O_2	Glycolic alcohol, H_2O_2 , H_2O_2 , Fo_2O_2 , Me_2O_2	Glyoxalic alcohol, H_2O_2 , $2\text{C}_2\text{O}_2$, Me_2O
De-ethylic alcohol, H_2O_2 , Ac_2O_2 (acetylic).	De-glycolic alcohol, H_2O_2 , H_2O_2 , Fo_2O_2 , Fo_2O_2	De-glyoxalic alcohol, H_2O_2 , $2\text{C}_2\text{O}_2$, Fo_2O_2
Acetite, H_2O_2 , (acetaldehyd). 2AcO	Glycolite, H_2O_2 , H_2O_2 , (oxyacetaldehyd). Fo_2O_2 , 2FoO	Glyoxalite, H_2O_2 , (glyoxal). $2\text{C}_2\text{O}_2$, 2FoO
Acetate, H_2O_2 , 2AcO_3	Glycolate, H_2O_2 , H_2O_2 , Fo_2O_2 , 2FoO_3	Glyoxalate, H_2O_2 , $2\text{C}_2\text{O}_2$, 2FoO_3
Acetoate, H_2O_2 , (oxyacetate). 2AcO_3	Glycoloate, H_2O_2 , H_2O_2 , (glyoxylate). Fo_2O_2 , 2FoO_3	Glyoxaloate, H_2O_2 , (oxalate). $2\text{C}_2\text{O}_2$, 2FoO_3

bonous acid adjunct which has been regenerated with elimination of two water molecules. In connection with the term "glyoxylate" the reader will not fail to recall to mind a very keen and spirited controversy, regarding the true formula of that water-salt, which was inaugurated last year at one of the meetings of the London Chemical Society, where Messrs. Perkin and Debus took a very prominent part. Having carefully pondered this interesting problem from the novel and more elevated standpoint of my "Typo-nucleus" theory, I feel confident that a condensed report of the results of my speculative labours will be welcomed by many as a pleasant and profitable interlude, while fresh data are being gathered on the rich and productive soil of experimental research. I have therefore bethought myself of embodying an epitome of my researches in the present communication, and shall at once proceed to state the leading topics of my programme, which I have found it advisable to divide into two parts. In the first part I shall expound the molecular changes accompanying the substitutional action of bromine and perbromide of phosphorus on the water-salts of acetic, glycolic, glyoxylic, glyoxalic, and oxalic acids. In the second part I shall expound the molecular changes which ensue when the dry or dissolved combinations of the bromacetic, dibromacetic, and bromoglycolic acids with the alkalis, oxide of silver, and oxide of ammonium are subjected to the decomposing influence of temperature. Let us then, in the first place, inquire into the contents of the first part of my programme.

PART I.

On the Principal Molecular Changes accompanying the Substitutional Action of Bromine and Perbromide of Phosphorus on the Water-Salts of Acetic, Glycolic, Glyoxylic, Glyoxalic, and Oxalic Acids.

Commencing with the acetate, its brominated derivatives—whether obtained by the action of bromine on that compound or by the more expeditious method of employing acetic anhydride instead—are the following three:—

(1) The α bromacetate, H_2O_2 ,
 2AcO_3 ,

(2) The α dibromacetate, H_2O_2 ,
 2AcO_3 ,

And (3) The α tribromacetate, 2AcO_3 ,

but the first two derivatives are believed to be so entirely destitute of the character of stability that they are immediately made to merge into the isomeric modifications of the—

β bromacetate = Fo_2Br_2 , 2FoO_3 ,

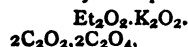
H_2O_2 .

and the β dibromacetate = Fo_2Br_2 , 2FoO_3 ,

while the third derivative, although endowed with the attribute of stability, is, under certain conditions, prone to pass into the β variety—



As regards the molecular changes attending these metamorphoses they are believed to consist, with reference to the first two derivatives, in the splitting up of the brom- or dibromomethyl adjunct into formyl-bromide, which instantly re-unites as adjunct with the residual formic or bromo-formic acid principal; but with reference to the third derivative the molecular changes are held to consist in the splitting up of the tribromomethyl adjunct into bromo-carbonous acid, $2\text{C}_2\text{Br}_2$, which, by its transition from the hydrocarbon type into the acid nucleus type, becomes now qualified to re-enter into chemical union with the residual bromo-formic acid principal. I have not as yet succeeded in gathering reliable data for studying the action of bromine on the glycolate and glyoxalate which, in theory, ought to give rise to the bromo-glycolate and bromo-glyoxalate. The first of these derivatives may, however, be got in another way,—namely, by treating the glyoxylate with perbromide of phosphorus, and decomposing the resulting bromoxyglycolyl-bromide, $\text{Fo}_2\text{Br}_2, 2\text{FoO}_4\text{Br}$, with water, where it is plain that the molecular changes must consist in the replacement by hydroxyl of that particular bromine molecule which forms a constituent element of the dioxyformyl-bromide principal; while the second may be got as an ether salt by treating the oxalate of ethyl and potassium,—



(the ordinary oxalovinate of potash), with oxybromide of phosphorus, where the previously-formed glyoxalic ether bromide,—



may be supposed to pass more or less readily into the isomeric bromo-glyoxylate of ethyl,—

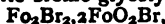


Reverting again to the above-mentioned bromoxyglycolyl-bromide, the reader will bear in mind that its formation depends upon the successive action of two molecules of perbromide of phosphorus on the glyoxalate, and, being impressed with the theoretical importance of the fact that a third molecule of perbromide is yet capable of acting substitutionally upon this derivative with production of a body which is found to be identical in all respects with the dibromoxyacetyl-bromide as obtained by the action of the perbromide on the dibromacetate, I have deemed it desirable of submitting to him a full analysis of the molecular changes which mark the various stages of the process. In taking for my guide the analo-

gous behaviour of the glycolate, when it is treated in succession with one and afterwards with another molecule of perbromide, and whereby it becomes converted first of all into oxyglycolyl-bromide,—



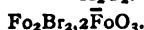
and subsequently into bromo-glycolyl-bromide,—



I proceed upon the hypothesis that the product of the action of the first molecule of perbromide on the glycolate is the dioxglycolyl-bromide, as expressed by the formula—



where the molecular changes consist in the replacement by bromine of that particular hydroxyl molecule which belongs to the oxyformate of water group; again, that the product of the action of a second molecule of perbromide on the latter derivative—namely, the above-mentioned bromoxyglycolyl-bromide—is expressed by the formula $\text{Fo}_2\text{Br}_2, 2\text{FoO}_2\text{Br}$, where the molecular changes consist in the replacement by bromine of that particular hydroxyl molecule which belongs to the colligated formylic alcohol group. But as regards the mode of formation of the third derivative, since, as our formula implies, there is no more hydroxyl to replace, it becomes manifest that the reaction must of necessity take a different course. This course, I venture to say, will consist in the previous conversion of the bromoxyglycolyl-bromide into the isomeric dibromacetate—



Thanks to this perfectly natural and intelligible metamorphosis our molecule has now put itself in possession of the much-coveted hydroxyl, so that the replacement of the latter by bromine can be accomplished without difficulty.

In reliance upon the general correctness of the foregoing, and I trust sufficiently lucid, explanations, I shall now proceed to contemplate the effects of temperature on the various brominated derivatives before us, and for that purpose direct the reader's attention to the second part of my programme.

To be continued.)

CORRESPONDENCE.

NEW PROCESS FOR THE QUALITATIVE DETECTION AND THE DETERMINATION OF POTASSA.

To the Editor of the Chemical News.

SIR,—In a paper on the above subject M. A. Carnot, in the CHEMICAL NEWS (vol. xxxiv., p. 85), describes a new method for the quantitative estimation of potassium, and towards the end of the paper he says:—

"The weight of the potassa is found on multiplying the weight of the sulphide of bismuth by—

$$\frac{3\text{KO}}{\text{Bi}_2\text{S}_3} = 0.549."$$

I think he must have calculated it by some new method, as it appears to me when calculated in the usual way to be—

$$\frac{3\text{KO}}{\text{Bi}_2\text{S}_3} = 0.320.$$

—I am, &c.,

September 4, 1876.

R. P. D.

DETERMINATION OF LITHIUM BY MEANS OF THE SPECTROSCOPE.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 94) there is a short notice of a paper by M. H. Ballmann on the

determination of lithium by diluting a solution of the metal till a drop, when ignited, ceases to give the characteristic spectrum. Two or three months ago I made a series of experiments with potassium and the alkaline earths, with the idea of estimating them in solution, by diluting till a measured quantity, generally 0.3 c.c., introduced into the flame, ceased to give the most characteristic line of the metal employed. I attached to platinum wires pellets of cotton-wool, or filter papers folded as if for burning, which were made to absorb the quantity of solution, then introduced into the edge of the Bunsen flame. After the drying and burning of the combustible matter, the ash, which is left in the state of a fine network impregnated thoroughly with the salt introduced, gets strongly ignited, and gives the desired spectrum. I found, however, that by diluting the spectra lost their brilliancy so imperceptibly that it was very difficult to fix the point at which they disappeared, especially so with the alkaline earths. It is possible thus to estimate the amount of potassium in a solution, the error allowed being about ten times the quantity of metal to be estimated.

I also tried diluting the solution till the line was equal in intensity to that produced by the ignition of a measured quantity of a very dilute solution of the metal of known strength, but met with no better success.

The results of these experiments, and the strain upon the eyes, produced by repeatedly looking attentively for a very faint line, or by looking for a line which you think ought to appear, induced me to give up this method of experimenting.

I would add that a filter paper (as before described) with so much solution of potassic chloride as contained 0.000006 grm. of metal, when ignited gave the K_a line distinctly. Roscoe gives 0.00000032 grm. of potassium as the minimum observable quantity; but by the nature of his experiment that quantity was introduced every second, whereas in the other case the minute portion was introduced once for all.—I am, &c.,

HENRY C. JONES.

Highbury, September 4, 1876.

MISCELLANEOUS.

British Association for the Advancement of Science.—The meeting of the British Association for 1877 will be held at Plymouth, and will commence on the 15th August. Dr. Allen Thomson, F.R.S., has been nominated President-elect, and the Vice-Presidents chosen are the Earl of Mount Edgumbe, the Earl of Devon, Lord Blackford, W. Spottiswoode, F.R.S., W. Froude, F.R.S., and C. Spence Bate, F.R.S. The meeting for 1878 will be held at Dublin. The following is a complete list of the papers brought before the Chemical Science Section of the Glasgow Meeting, under the Presidency of Mr. W. H. Perkin, F.R.S.; they will be published in full or in abstract, according to their importance, in the CHEMICAL NEWS:—

M. M. P. Muir, F.R.S.E.—On Essential Oil of Sage.

J. A. R. Newlands.—On Relations among the Atomic Weights of the Elements.

C. H. W. Biggs.—On a New Voltaic Battery.

J. J. Coleman.—On a Gas Condensing Machine for the Liquefaction of Gases by Combined Cold and Pressure.

W. Ramsay.—On Picoline.

J. E. Stoddart.—Lead Desilverising, by the Zinc Process.

Dr. Corfield.—Report of Sewage Committee.

A. H. Allen.—Report on Commercial Phosphates and Potash Salts.

J. Banks.—Sewage Purification and Utilisation.

J. J. Coleman.—Experimental Researches on the Chemical Treatment of Town Excreta.

Professor Gamgee.—On the Physiological Action of Pyro-, Meta-, and Ortho-phosphoric Acids.

F. H. T. Allan.—On a Safe and Rapid Evaporating Pan.
Professor Thorpe, F.R.S.—Report on Specific Volumes of Liquids.
Dr. Atkinson.—Report of Committee for the purpose of Collecting and Suggesting Subjects for Chemical Researches.
Walter Weldon.—On the Means of Suppressing Alkali Waste.
Dr. Macvicar, F.R.S.E.—On the Possible Genesis of the Chemical Elements out of a Homogeneous Cosmic Gas or Common Vapour of Matter.
J. Emerson Reynolds, M.D.—On Glucinum: its Atomic Weight and Specific Heat.
G. Johnstone Stoney, F.R.S.—On the Atomicity of Oxygen and on the Constitution of Basic Salts.
E. H. W. Biggs.—On a New Voltaic Battery.
W. H. Perkin, F.R.S.—On New Anthracen Compounds.
J. B. Brown.—On Anthracen Testing.
Professor Guthrie, F.R.S.—On Solid Water.
Dr. C. R. A. Wright.—On the Alkaloids of the Aconites. On New Cotarnine Derivatives.
C. T. Kingzett.—On the Oxidation of Terpenes. Part IV.
Professor Crum Brown.—On the Action of Pentachloride of Phosphorus on Turpentine.
A. C. Lettis.—On Two New Hydrocarbons from Turpentine.
J. V. Buchanan.—On some Instruments Used in the "Challenger."
Professor Gladstone, F.R.S.—The Influence of Condition and Quantity of the Negative Element on the Action of the Copper-Zinc Couple.
W. N. Hartley.—On the Critical Point of Liquid Carbonic Acid in Minerals.
R. D. Silva.—On the Action of Hydriodic Acid on Mixed Ethers of the General Formula $C_nH_{2n+1}O.CH_3$.
Dr. Cameron.—On Ammonic Seleniocyanide.
J. A. R. Newlands.—On the Alum Process in Sugar Refining.
E. M. Dixon.—On an Apparatus for the Analysis of Impurities in the Atmosphere.
W. Henderson.—History of Copper Extraction in the Wet Way.
J. Maclear.—Soda Manufacture.
E. C. C. Stanford.—Iodine and Associated Products.
J. Dunnachie.—Fire-Brick, &c.
T. L. Patterson.—Sugar.
D. Swan.—Zinc.
J. Macrobarts.—Dynamite.
F. Ward.—On the Prevention of Fraudulent Alterations in Cheques, &c.
Anderson Smith.—On Sodium.
M. M. P. Muir.—On the Action of Dilute Saline Solutions on Lead.—On some Compounds of Bismuth.
Prof. Dewar.—Transformation of Chinoline into Aniline.
W. A. Tilden, D.Sc.—On the Nitroso Derivatives of the Terpenes.—Preliminary note on a new Isopurpurine.
W. Dittmar.—On the Proximate Analysis of Coal Gas.—Remarks on Reboul's paper on Pyro-Tartaric Acid.
W. Thomson, F.R.S.E.—On the Action of different Fatty Oils upon Copper.—On the Growth of Mildew on Grey Cloth.
A. Fergusson.—White Lead.
Col. Hope, V.C.—On the Purification of the Clyde.
W. C. Sillar.—On the Utilisation of Sewage.
Rev. R. Thomson.—The Prevention of the Pollution of Rivers.

The total number of tickets sold during the Meeting was 2731. Of these 211 were to old life members, 31 to new life members, 318 to old annual members, 208 to new annual members, 1243 to associates, 696 to ladies, and 24 to foreign members. The total amount of receipts up to Tuesday evening was £2983.

Iron and Steel Institute.—A meeting of the Iron and Steel Institute will be held at Leeds on the 19th, 20th, 21st, and 22nd inst. The following is a list of papers and subjects for discussion:—

Professor Green, "Geological Features of the neighbourhood of Leeds."
G. Dove, jun., "The North Lincolnshire Iron District."
Henry Kirk, "Some Features of Revolving Puddling Furnaces and their Products."
Bashley Britten, "Glass from Blast-Furnace Slag."
R. Howson, "On Welding Iron."
G. J. Snelus, "Further Information as to the use of Molten Iron direct from the Blast Furnace." (Discussion.)
John Jones, "Technical Education in connection with the Iron Trade."

"Chymistry" and Force.—Professor Tait, in his discourse a few nights ago upon "Force," instanced as one of the things that force cannot accomplish the inability of the *Times* to make scientific men spell "chemist" with a "y." Those who have remarked the persistency with which the *Times* adheres to "chymist," may have reflected on hearing this that forces in this respect are evenly matched, and that if the journal cannot coerce men of science, they in turn are powerless to alter the practice of the journal. Professor Tait, however, has succeeded where the combined forces of chemists and grammarians have failed. The *Times* reported his speech, and his speech would have been incomplete without his illustration. The illustration would have been fruitless unless chemist was spelt with an "e," and with an "e" accordingly the *Times* spells it, for the first time, probably, within the memory of man. It is true that the offending orthography appears within inverted commas, but the fact remains, nevertheless, that Professor Tait has developed a force to which the leading journal has succumbed. He has compelled the *Times* to spell "chymist" with an "e."—*Glasgow News*.

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2. English, Modern Geography, and English History—W. J. Craig, M.A., Trin. Coll., Dublin.
3. Mathematics and Natural Philosophy—The Rev. J. T. Bell, M.A., late Fellow of St. Catherine's Coll., Camb.
Chemistry—T. Eliott, F.C.S.

Fee for the Course of Three Months, £10 10s. The Class is not confined to Students of the Hospital.

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Botany—The Rev. G. Henslow, M.A. Cantab., Lecturer on Botany to the Hospital.
Zoology and Comparative Anatomy—Norman Moore, M.D. Cantab., Lecturer on Comparative Anatomy to the Hospital.
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Pathology—Dr. Sutton.
Diseases of Throat—Dr. Morell Mackenzie.
Anatomy and Pathology of the Teeth—Mr. Barrett.

The next Winter Session will commence on Monday, October 2nd, when the Introductory Lecture will be given by Dr. Andrew Clark, Senior Physician to the Hospital.

The Perpetual Fee to Lectures and Hospital Practice, with two years' Practical Anatomy, is 90 guineas if paid in one sum, or 100 guineas if paid by three instalments. Special entries can be made to Lectures or Practice. The Hospital contains about 800 beds. The in-patients during 1875 were 5804, and the out-patients 40,717.

1. Two Entrance Science Scholarships, value £60 and £40.
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3. A Scholarship, value £20, in Human Anatomy, for first year Students.
4. A Scholarship, value £25, in Anatomy, Physiology, and Chemistry, for first and second year students.
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For further particulars apply to the Registrar, at the Hospital, or to A. B. SHEPHERD, M.B., Dean of the School.

St. Mary's Hospital Medical School.
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OPENING OF WINTER SESSION, October 2nd, 1876.—Introductory Address by Dr. Wiltshire.

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4. Mineralogy. By Warrington W. Smyth, M.A., F.R.S., Chairman.
5. Mining.
6. Geology. By John W. Judd.
7. Applied Mechanics. By T. M. Goodeve, M.A.
8. Physics. By Frederick Guthrie, Ph.D., F.R.S.
9. Mechanical Drawing. By Rev. J. H. Edgar, M.A.

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WINTER SESSION, 1876-7.

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The Matriculation Examination will be held on the 30th of September, at 10 a.m. Fee £1 1s. Candidates for the Scholarship, as well as those who select any of the voluntary subjects as an addition to the obligatory ones, are requested to inform the Principal of their intention, and to name the subjects at least a week previously to the Examination.

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August, 1876.

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THEO. WOOD BUNNING, Secretary.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 878.

RESEARCHES ON THE CHEMICAL TREATMENT OF TOWN EXCRETA.*

By J. J. COLEMAN, F.C.S., Assoc. Inst. Eng. Scot.

PRESENT methods of dealing chemically with sewage resolve themselves into, first, treatment with lime; secondly, treatment with metallic oxides or salts; and, thirdly, treatment with carbon.

In reference to the lime process chemists are familiar with the literature upon the subject.

The second method, viz., the use of a metallic oxide or salt has certain advantages when the precipitant can be obtained cheaply and the sewage to be dealt with is largely contaminated with refuse from dye-works, as is the case at Leeds and Coventry. Subsulphate of alumina has been used in such cases. The third method of dealing with sewage, viz., by the agency of carbon, appears to me to be most generally useful, for whilst possessing the power of abstracting noxious matter from the sewage in at least as great a ratio as any chemical that can be used, the carbonaceous deposits are not liable to subsequent noxious decomposition, and the manual value of the mud is not interfered with. In practice carbon is used in processes such as the A B C, where alum is an essential part of the system.

The efficiency of carbon for these purposes is doubtless dependent upon its being in a fine state of division, and in practice a cheap form of carbon, suitable for deodorising, has not been by any means easy to get. Common coke, peat charcoal, carbonised street sweepings, and, as proposed by Mr. Stanford, carbonised excreta, have been proposed or actually used, but all these forms of charcoal require expensive and cumbersome plant in the form of retorts, and condensing arrangements for vapours evolved in the distillation, and involve a large consumption of fuel for carbonisation, so that I have never known of any kind of charcoal being obtainable under at least 10s. per ton prime cost, the market price being generally from 20s. to 60s. per ton. My attention has been directed to a waste product produced largely—in fact, to the extent of 500,000 or 600,000 tons annually in Scotland alone. I mean the carbonised shale after removal from the retorts of our mineral oil works. The quantity of fixed carbon it contains ranges about 10 per cent, and its state of division no doubt is similar to that contained in bone-black, the carbon in the former case being associated with silicates of alum, lime, and of magnesia, and, in the latter, with phosphates and carbonates of lime. An analysis of the mineral constituents shows the following composition, the material having been dried at 60° F. :—

Silica	46.28
Alumina	27.01
Oxide of iron	7.63
Phosphoric acid .. .	0.43
Lime	1.41
Magnesia	1.00
Fixed carbon and water	16.24

100.00

I have made a number of experiments as to its power of deodorising. In the month of May, 1875, I prepared several mixtures of human fæces with the material. The fresh fæces were first diluted with half their weight of urine.

A weighed portion of the mass was taken, and mixed

with an equal weight of carbonised shale powder. The powerful odour of the fresh fæces was rapidly destroyed, the mixture became odourless, and I preserved samples in partially closed wide-mouthed bottles. During 10 days and at a temperature of 60° F. no foetid or unpleasant smell was noticeable, and the mass being somewhat pasty I mixed it with more shale powder, so as to bring it to a pulverulent state suitable for sowing by hand as a manure, and the sample has been kept until this date without emitting the least smell of organic putrefaction. Subsequently to this and in the month of June, 1875, experiments were made with the object of comparing its action with that of bone and wood charcoal. The same mixture of fæces and urine was used. As the general result of these experiments it was found that whether animal charcoal or carbonised shale were used the proportion of one part of carbon to two of excrementitious matter was insufficient to prevent a slight putrefactive smell, after the lapse of two or three weeks, but that equal parts of excrementitious matter and carbon formed a permanently odourless mass, whether animal charcoal or carbonised oil shale were used. It appears therefore that for deodorising excreta carbonised oil shale requires to be used in the same proportion as excreta charcoal is recommended to be used by Mr. E. C. C. Stanford. Experiments were also made with urine alone, in the proportion of one part of carbonised shale powder to 4 of urine. The latter was gradually changed into a liquid smelling purely of ammonia and without the slightest putrefactive smell although it was kept some weeks.

In order to make experiments with sewage the City Statute Labour Trust of Glasgow supplied sewage collected from the following points :—

1. Sandysfauld's Street, Caledonia Road;
2. Duke Street;
3. Great Hamilton Street;
4. Gloucester Street;
5. Sauchiehall Street.

These samples were mixed so as to get a fair average, and coming from water-closet districts in dry weather, the smell was most offensive. It was divided into two portions. The first portion was agitated for ten minutes with finely divided bone-black in the proportion of 100 grains to the gallon, and the mixture was then thrown upon a funnel partially plugged with sponge, the liquid being collected. The second portion was agitated with a similar quantity of carbonised oil shale in the same proportion and manner. Both these filtrates came through deodorised, and have kept sweet to the present time. Examined some months afterwards after being kept in closely stoppered bottles, the unfiltered sample contained 4.210 free ammonia in 100,000 parts, and the sample, filtered through the carbonised shale, contained 0.428 free ammonia.

In regard to albuminoid ammonia the unfiltered sample contained 0.333 part and the filtered sample 0.285 part. In reference to the adaptability of the material for the dry-closet system, the ease with which it can be reduced to a soft charcoally powder is a great recommendation. Since these laboratory experiments have been made they have been confirmed by experiments on a large scale, and more particularly with the refuse from the water-closets and surgical wards of the Glasgow Royal Infirmary—the excrementitious matter from which is about as repulsive as any that can be met with. It is semi-liquid in character, and an experiment conducted by the author in conjunction with the medical superintendent proved that on mixing about 2 cwts. of this material with the same weight of the carbonised shale, it was, in the course of a few minutes, completely deodorised.

Experiments have been also made by the Sanitary Inspector of the City of Glasgow. His report to the Police Board, dated January of the present year, includes description of experiments made with about 7 tons of the ground material in three of the public privies of the city, and extending over a period of fifty-seven days.

The Sanitary Inspector fully endorsed the conclusions arrived at by the author as to the powerful deodorising

* Read before the British Association, Glasgow Meeting (Section B.)

effect of the substance, and strongly recommended its regular use by the city authorities.

Glasgow public conveniences are, however, most of them on Macfarlane's water-trough system, and the difficulty of adapting self-acting mechanical arrangements to them prevented the adoption of a dry method, as also the fact that a Royal Commission on the subject of dealing with Glasgow sewage was then sitting.

In treating sewage with the material upward filtration might be resorted to, or the carbonised shale might be employed in constructing, upon the sandy foreshores of the river, filters to be eventually converted to soil, or the material could be used as an adjunct to earth intermittent filters, or as an ordinary filter, combined, if necessary, with depositing tanks.

Perhaps the best plan of utilising it would be the latter, the material being ground to a fine powder, and poured into the main sewer about 100 yards from the outfall, so as to establish thorough mechanical agitation; the mixture could then be allowed to deposit in tanks, and the clear overflow filtered through a filter of the same material in a coarsely powdered or crushed state.

It will be in the recollection of members of this Section that our distinguished past President, Sir John Hawkshaw, has been acting as Royal Commissioner appointed to inquire as to the purification of the River Clyde.

The report of the Royal Commissioner, which deals with the whole valley of the Clyde, recommends, however, chemical processes or irrigation for some of the smaller towns of the valley only, and goes on to express an opinion that he can see no other course in dealing with the sewage of Glasgow than running it to the sea with engineering works, estimated to cost 2½ millions sterling, and including a tunnel 30 or 40 miles long.

The Royal Commissioner, however, appears conscious himself that chemical science may eventually solve the difficulty, for towards the close of his report he remarks these engineering works would not be thrown away by improved methods of treatment at the outfall. If chemical science can suggest a means of lessening the enormous expenditure of two and a half millions Sir John appears to think necessary, I feel no doubt the Royal Commissioner would be gratified. The tunnel scheme is a suggestion: the absolute recommendations of the Royal Commissioner being statesmanlike proposals for organising a Board of Sanitary Commissioners for the Clyde Valley, with certain definite powers, leaving it with local townships to carry out any particular plan of purification that may be agreed upon and approved of by the central authority he proposes to create.

Sir John Hawkshaw, in the course of his enquiry, investigated the chemical processes in use in other towns, and discussed with much care the problem of dealing with the sewage of the second city of the Empire, which amounts in dry weather to 48,000,000 gallons daily.*

Whilst approving of dry-closet systems in regard to public works and in particular circumstances, the Royal Commissioner does not see how such a revolution can be effected in large towns as the abolition of water-closets.

After dismissing irrigation as impracticable from want of suitable land, and a strong objection to making experiments with ratepayers' money in farming, the report enters into the discussion of chemical processes *versus* gravitation to the sea.

The arguments Sir John uses, independently of any bearing they have on the author's proposals, are of interest generally in regard to the question of dealing with the sewage of any large city, and I may also add particularly to irrigationists, in respect to the dealing with the sewage mud, which it is impossible to deliver over square miles of land by the pipes employed in irrigation.

The Royal Commissioner uses these words—"By the addition of suitable deodorising and precipitating agents, such as alum, clay, lime, and charcoal, then allowing the

solid matters to subside, and afterwards filtering the prepared liquid through prepared filters to be used intermittently, I believe that the whole of the sewage of the City of Glasgow might be discharged into the Clyde without causing a nuisance to the neighbourhood."

The adoption of a chemical method is condemned for the following reasons:—

- (1.) It is argued that, assuming the daily flow of Glasgow sewage to be 48,000,000 gallons, the solid matters in the sewage suitable for carting would probably amount to 186,000 tons per annum.
- (2.) That the lime used for precipitation would probably increase the weight of this mud to between 400,000 or 500,000 tons annually.
- (3.) That on information received from Mr. J. B. Lawes and Mr. Caird, that the annual consumption of artificial manures in the United Kingdom does not exceed 800,000 tons, he does not see how Glasgow could dispose of 400,000 or 500,000 tons.
- (4.) That judging from the balance-sheets of the sewage works at Leeds the cost of dealing with Glasgow sewage chemically would be £80,000 per annum.

Now in respect to the first argument. Glasgow sewage was analysed by the Rivers Pollution Commissioners under the superintendence of Dr. Frankland in 1870 ("Riv. Poll. Com.," Fourth Report, p. 26). It contains, in round numbers, 142 parts of solids per 100,000, which is equal to about 100 grs. per gallon. Again, Dr. Hofmann, in his Report on London Sewage,† estimates its average composition as 100 grs. solids per gallon. Glasgow sewage, owing to the plentiful rainfall and abundant water-supply from Loch Katrine, is weaker than that of other towns; so that it is impossible that 48,000,000 gallons per day of sewage could give more than 100,000 tons per annum of solids, supposing the effluent be discharged as pure as distilled water.

From this quantity must be deducted the soluble saline constituents, reducing it, say, four-tenths, or to 60,000 tons; and there must be added the moisture contained in artificial manures, say 25 per cent, which gives us as the probable correct figure 80,000 tons as the annual probable quantity of solids separable from Glasgow sewage in the form of manure.

That this figure is correct is confirmed by Prof Way's‡ report on the sewage of towns, which would bring out the quantity 91,000 tons. Mr. J. B. Lawes's estimates would bring out 89,000 tons according to the ratio of 2 to 3 lbs. solids per ton. Finally, the experiments of Mr. Keates§ at Crossness showed that 142 tons of prepared manure was obtained from 11,672,751 gallons of London sewage; 61 tons representing the mud precipitated from the sewage. This would indicate 80,000 tons per annum for Glasgow sewage, which I assume to be correct in place of the 186,000 tons assumed by Sir John Hawkshaw.

In regard to the next argument of the Royal Commissioner, that the solids would be more than doubled by the lime process, this is difficult to see, as lime is only added as a fraction of the solids. It may be correct as regards carbon processes, but even then the annual production of manure would be 160,000 to 200,000 tons instead of the 400,000 or 500,000 tons estimated by Sir John.

In reference to the third argument that the manure could not be disposed of. If sewage mud be classed with artificial manures of several pounds value, which appears to be what Messrs. Lawes and Caird include in their figures of 700,000 or 800,000 tons annual consumption of the United Kingdom, then I agree with the Royal Commissioner. But this is not the case. Sewage mud manure has only a few shillings value, and should be compared with city street sweepings manure, of which the City of

* Hofmann and Witt, "Report on London Sewage;" also "Corfield on Sewage," 179 to 184 inclusive.

† See "Reports of Sewage of Towns Commissioners."

‡ See Mr. Keates's "Report to the Metropolitan Board of Works."

* Bateman and Bazalgette's "Report," 1868. Sir John Hawkshaw's "Report," 1876.

Glasgow alone dispose annually to farmers no less than 200,000 tons, at prices varying from 2s. to 2s. 6d. per ton.*

The final argument of the Royal Commissioner is that a chemical process would cost Glasgow £80,000 per year, including interest upon capital and expenses, taking the experience of Leeds as a guide. This is founded upon the assumption that the cost of the process would be the same here as at Leeds, and, secondly, that the product is unsaleable.

Judging from the experience of Leeds, the cost of chemicals required for dealing with Glasgow sewage would be 43,800 annually, equal to about 10s. per ton of sewage mud.

The substitution of the carbonised shale for the charcoal, &c., bought at Leeds would probably reduce the expenses to 5s. per ton—making the total £56,000; the total expense would then run thus—

Chemicals	£20,000 annually.
Working expenses	16,000 "
Interest on capital	20,000 "
	£56,000

Against this must be set the value of the manure. At the price of street-sweepings it would be £25,000, and at a little more than double the price would cover the costs of the process; whilst, on the other hand, the interest upon an expenditure of two and a half millions of money in engineering works would be £100,000 per annum.

Before leaving this subject it may be remarked that experiments made in the neighbourhood of the metropolis have been on such a small scale that they are utterly useless in judging of the results which could be attained with the sewage of a large city.

This is noticeable in reading reports of the costs of manipulation, and more particularly the cost of drying sewage mud. Of course, large cities like Glasgow, near extensive coal-fields, have enormous advantages in cheap coals, but the evaporation of a given amount of water when heat is properly and continuously applied is subject to definite rules, and the results I have seen in printed statements of costs show such a grave departure from the results of engineering practice, that I should feel confident of much more successful results in the intelligent management of the sewage of extensive centres of population, such as are found in this city.

REPORT ON THE LIMITED OXIDATION OF ESSENTIAL OILS, PART IV.; CONTAINING A PRELIMINARY REPORT ON THE ETHERS.†

By CHARLES T. KINGZETT, F.C.S., London
and Berlin, &c.

A. Oxidation of Turpentine.—Since my last publication on terpenes and the products of their limited oxidation, I have had the opportunity of repeating the whole of my observations upon the aqueous solution that results when turpentine is oxidised by a current of air in the presence of water. This opportunity has been afforded me while experimenting upon no less than fifty gallons of turpentine; and while in no one particular have I to withdraw or alter any of my original statements, certain matters have come more strongly before my observation which are worthy of some notice. Before proceeding to summarise these it will be well to recapitulate the main products of the oxidation. My past researches, then, have established that turpentine yields when oxidised in the way I have

described, peroxide of hydrogen, and camphoric acid (both of which may result from the action of water upon camphoric peroxide, $C_{10}H_{14}O_4$), acetic acid, camphor, and certain other less defined substances. The oil itself increases in specific gravity and contains after this treatment certain oxidised bodies, among which is a further quantity of this camphoric peroxide.

I have been able to indicate the rate at which this oxidation takes place, and to investigate more fully the nature and uses of the solution I have described. And in doing so I have experimented with large earthenware vessels arranged in a series like so many Wolfe's bottles, each of about 20 gallons capacity.

The oxidation proceeds very slowly at first, the rate being indicated by the estimation from hour to hour of the peroxide of hydrogen which is formed; but when once the oxidation has fairly set in, it proceeds more rapidly, with increasing production of peroxide of hydrogen and the other products, the amounts of which are simply limited by that of the turpentine itself. Now, assuming the operation to be started with a given quantity of turpentine in the presence of a given quantity of water at, we will say, 60° C., the turpentine begins slowly to oxidise and produce the bodies named, which then pass into solution, while the oil itself increases gradually in specific gravity, a phenomenon which is accompanied by a gradual rise in its boiling-point. Now, if no fresh turpentine be added to that already in operation there will come a time when the percentage of peroxide of hydrogen is at a maximum, and then if the blowing be continued after that time it slowly diminishes, in fact at about the same rate that it forms. If, on the other hand, the turpentine which is blown away as vapour be condensed and returned to the oxidiser, or what amounts to the same thing, if fresh turpentine be added the oxidation proceeds as rapidly as ever, while there is no limit to the amount of peroxide of hydrogen which is formed.

It is remarkable that turpentine in the act of being oxidised is capable of imparting to fresh turpentine the same and equal facility to absorb oxygen.

The slow rate at which the oxidation of fresh turpentine proceeds, and the greater rate attained after the molecules have undergone the change which induces a rapid oxidation is seen by the following figures which relate to an experiment conducted on some gallons of turpentine and water

	Grms. of H_2O_2 in 100 c.c. Solution.
After 37 hours	0.0651 grammes H_2O_2
" 41 "	0.2000 " "
" 54 "	0.3000 " "
" 58 "	0.4500 " "

The increase that takes place in the specific gravity of the oil of turpentine as the oxidation proceeds is exemplified by the following figures which relate to another experiment:—

	0.864 originally
After 24 hours the sp. gr. of the oil	= 0.880
" 28 " " "	= 0.881
" 32 " " "	= 0.888
" 44 " " "	= 0.949
Again—	
After 16 " " "	= 0.8886
" 20 " " "	= 0.8996
" 26 " " "	= 0.9060
" 39 " " "	= 0.9136
" 46 " " "	= 0.9366
" 48 " " "	= 0.9476

The increase in the boiling-point of the oil as the oxidation proceeds is illustrated by the following determinations, which relate also to a different experiment.

The turpentine used in this experiment boiled as indicated in column (1).

* "Reports of the Cleansing Committee of the Police Board of Glasgow."

† Read before the British Association (Section B.), Glasgow Meeting.

(1) Original Oil.	(2) Oil after 24 hours' Oxidation.	(3) After 27 hours' Oxidation.
10 p. c. over at 157° C.	162° C.	165° C.
20 " " 159	165.5°	166
30 " " 160	168	170
40 " " 160	171	171
50 " " 160.5	174	174
60 " " 161	181	185
70 " " 162	193	206
80 " " 164	210	—
90 " " 166	—	—

In regard to these boiling-point determinations I should remark that in each case 100 c.c. were subjected to distillation in the way that is usual in these matters, and the temperature recorded after each 10 c.c. was collected. It is necessary also to point out that the oil, although it has been oxidised in the presence of water, is yet so full of the organic peroxide I have discovered and described in my previous researches, that when it has once reached a temperature of 160° C or less, a violent effervescence sets in from the escape of oxygen, and much heat is eliminated, as indicated by the rise in the thermometer after the lamp has been removed. I shall conclude this part of my paper by stating that having been led by the value of the solution as an antiseptic and disinfectant to attempt the manufacture of it and the residual oil I have described, on a commercial scale, I have devoted a great deal of time to the study of those conditions which are calculated to lead to the most desirable results. In this attempt I have received much help from Mr. J. Brown, F.C.S., which I have the pleasure to acknowledge. For I have been so far successful as to obtain under certain conditions readily from an inconsiderable amount of turpentine, water, and air a solution containing such large quantities of peroxide of hydrogen and the other substances above named, as to qualify it for purposes and uses upon which I propose to dwell in Section B of my report. I find that a solution containing so much peroxide of hydrogen as to be capable of evolving from 1 litre either 1531 c.c. oxygen or 3062 c.c. oxygen, according as one or both molecules of oxygen (in H_2O_2) are affected, has all the properties which I propose to describe; but before doing this I must add that these properties are far from being entirely dependent upon the peroxide of hydrogen contained. They are related also to the camphoric acid and other constituents, for they are not seriously impaired by the total destruction of the peroxide of hydrogen. This I have substantiated in an experimental way, and shall now proceed to describe the experiments themselves. These I shall only preface by stating that a solution which contains 323 grains of

peroxide of hydrogen to the gallon also contains 367 grains of camphoric and acetic acids. But the percentage of each constituent and the strength of the whole mixture are matters to a great extent under control in the method of preparation.

B. Antiseptic and Disinfecting Powers of the Solution.—In studying the properties of the solution I have described I discovered that it possessed great power as an antiseptic and disinfectant, and I was led to investigate this matter somewhat fully, also to enquire into similar properties possessed by the known constituents of my solution, and in comparison with those of salicylic acid.

In the experiments given at foot of page the solution employed was of that general strength I have indicated above, and contained 2.5 grms. H_2O_2 per litre. All these experiments were made during October and November, 1875.

Those now to be given were made during June, July, and August, 1876. The antiseptic solution employed was not so strong as that used above.

	With 3.5 c.c. Antiseptic = 10 per cent.	With 1.75 c.c. Antiseptic = 5 per cent.	With 4 c.c. neutral Antiseptic = 11 per cent.
White of egg, 35 c.c. in each case.	Kept fresh for 35 days, then mould appeared. No stink.	Fresh for 21 days, then mould appeared. No smell.	Fresh for 35 days, then mould appeared. No smell.

The only other alteration in each case was a slight darkening to brown in the colour of the albumin. But after each experiment the albumin had still its coagulable character and was not otherwise changed.

After dipping in the same solution, brain matter also kept fresh for several days, whereas without such treatment, it stunk on the next day.

Milk was also preserved for a much longer period than without, but not for so long a period as in the winter months.

Beer was also thoroughly preserved for a number of days, as long as observed; so also was blood serum. Stinking water recovered and remained good with it for months.

In conclusion I would only add that I have never examined seriously the influence of less percentages than those detailed, but there can be no doubt that much less quantities could be used in many cases with the same effects as those described. In fact this would be necessary with articles of food on account of the aromatic odour and peculiar taste of the solution.

(To be continued).

Article Experimented upon.	Antiseptics Used.	Result.	With equal vols. of water and no antiseptic.
Egg albumen, 50 c.c. containing 10 c.c. white of egg in each case.	5 c.c. neutralised by soda = 10 per cent.	Observed 24 days still fresh as at first.	Began to stink on 2nd day after.
Must from muscatel grapes, 50 c.c. taken in each experiment.	10 c.c. neutral antiseptic = 20 per cent.	No fermentation, even after days.	Soon fermented at 40° C., giv. alcohol.
Milk, 200 c.c. in each case.	10 c.c. neutral antiseptic = 5 per cent.	Faintly acid on 5th day after, solid on 7th day.	Solid and sour on 3rd day after.
Urine, 60 c.c. in each case.	10 c.c. antiseptic = 16 per cent.	Unchanged after 7 days, no longer observed.	Bad smell 2nd day, stunk on 3rd day.
Brain matter, 10 grms. in each case.	10 c.c. antiseptic.	Kept fresh 15 days, no longer observed.	Stunk on 3rd day after.
Milk, 100 c.c. in each case.	10 c.c. antiseptic = 10 per cent.	Liquid, and sweet for 9 days.	Sour and solid on the 2nd day after.
Flour paste, 100 c.c. in each case.	10 c.c. antiseptic = 10 per cent.	Fresh after 19 days, no longer observed.	Stunk on the 3rd day.
Milk, 160 c.c. in each case.	10 c.c. antiseptic = 6 per cent.	Solid and sour after 7 days.	Bad on the 2nd day, very bad on 3d day.
Bitter Beer, 160 c.c. in each case.	10 c.c. antiseptic = 6 per cent.	Still good and unchanged on 7th day, no longer tested.	Thin films on 2d day, fungus over surface on 3rd day.

THE CHEMICAL CONSTITUTION OF THE
HIGHER ACID HETEROLOGUES
OF THE
ETHYLIC, GLYCOLIC, AND GLYOXALIC
ALCOHOLS,

AS VIEWED AND INTERPRETED FROM THE STANDPOINT
OF THE "TYPO-NUCLEUS" THEORY.

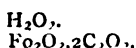
(Concluded from p. 122.)

By OTTO RICHTER, Ph.D.

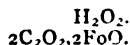
PART II.

On the Principal Molecular Changes which ensue when the Dry or Dissolved Combinations of the Bromacetic, Dibromacetic, and Bromo-glycolic Acids, with the Alkalies, Oxide of Silver, or Oxide of Ammonium, are subjected to the Decomposing Influence of Temperature.

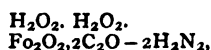
When the dry bromacetates of potassium, silver, or ammonium are heated up to a certain point they are found to yield the bromides of these metals along with glycolide, to which I ascribe the formula—



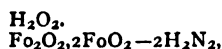
a formula which must not be confounded with that of the isomeric glyoxal,—



The formation of this body is due to the splitting up of these bromacetates into the hydrates of their respective bases, and the subsequent transposition of the latter with the colligated formyl-chloride of the residual oxybromaceten, $\text{Fo}_2\text{Br}_2, \text{C}_2\text{O}_2$. When heated in the presence of water the aforesaid bromacetates will again produce the metallic bromides, but instead of glycolide we shall now obtain the water-salt of glycolic acid. Let us, in the next place, contemplate the effects of heat upon dry ammonium bromacetate in the presence of ammonia. The chief products of this reaction are found to be ammonium bromide and β glycolamide or glycolcol, to which I assign the formula—

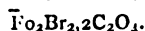


which implies that, in harmony with established facts, this body is endowed with the twofold character and functions of a feeble organic base and a feeble organic acid. In this metamorphosis we have again, in the first stage, the formation of ammonium bromide and glycolide; but as regards the precise nature of the molecular changes attending the second stage of the process, and which are due to the substitutional action of ammonia on the newly formed glycolide, I am obliged to reserve my explanations for another opportunity. The same remark applies also to the α glycolamide,—

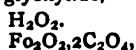


which derives its origin from the substitutional action of ammonia on the water-salt of glycolic acid.

Let us now proceed to consider the effects of temperature upon the metallic dibromacetates. According to Mr. Perkin, when dibromacetate of silver is strongly heated it splits up into silver bromide and an insoluble powder, which is evidently bromo-glycolide,—



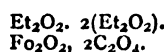
When the dry bromo-glycolate of sodium—obtained by treating the bromo-glycolide with hydrate of sodium—is strongly heated in its turn, and the contents of the retort brought into contact with water, the sodium bromide is dissolved out, while glyoxylide,—



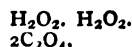
remains behind in the form of an insoluble amorphous white powder. From this the ammonium glyoxylate may be readily obtained by treatment with aqueous ammonia. Now, it is stated by Mr. Perkin that when this ammonium-salt is evaporated *in vacuo*, the solution, although neutral at first, always becomes acid, and that without loss of ammonia, and ultimately yields a crystalline product having the same outward appearance and empirical formula as the *soi-disant* ammonium glyoxylate which Dr. Debus professes to have got by similar treatment, and an aqueous solution of which, he assures us, gave all the reactions of a genuine ammonium-salt. Mr. Perkin, on the other hand, was not slow in drawing attention to the fact that his crystalline powder, which I take to be a glyoxylamide with the formula—



was very prone to assimilate water with reproduction of the original ammonium-salt,—a circumstance quite in keeping with his view of the matter. In weighing the arguments brought forward by these two distinguished London chemists, I cannot help believing in the identity of the crystalline powders obtained by Mr. Perkin and Dr. Debus, and that they possess the chemical constitution which my formula attributes to them. As regards the unexpected manifestations of acidity, &c., during the process of evaporation, I may remark that a similar phenomenon was noticed by Mr. Perkin in another experiment, with this material difference, however, that the change in question was superinduced not by the abstraction of the aqueous solvent, but, on the contrary, by its addition. In the words of Mr. Perkin, "When bromo-glycolate of silver was heated with a large excess of absolute alcohol in a sealed tube, the latter, after several hours' heating, was found to contain a clear liquid and a bright yellow powder. The liquid proved to be totally neutral to test-paper, which in contact with a drop of water began to turn red, plainly proving that the newly-formed glyoxylic ether was undergoing decomposition." As I intend reverting again to these remarkable manifestations, I shall proceed to describe the molecular changes when glyoxalate of water is heated with absolute alcohol to 120° . The resulting product is designated by the author as the diethyl-glyoxylate of ethyl, but if my mode of reasoning is correct its proper name will be the ethyl-glyoxylate of diethyl, with the formula—



By this formula the compound before us is shown to be a triatomic ether-salt of glyoxylic acid, in which the acid principal is no longer the monobasic oxyformic acid, $2\text{H}; 2\text{C}_2\text{O}_5$, as it exists in the water-salt, but the bibasic carbonic acid, capable of saturating two molecules of ether base. Let us now imagine the replacement of one of these two ether molecules by the molecule of basic water which is engendered during the conversion of the aforesaid oxyformic into carbonic acid, and it becomes evident that the resulting compound, which I hold to be identical with the well-known carbovinate of water,—

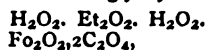


ought to betray, as it does in fact, a distinctly acid reaction.

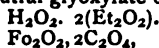
The preceding remarks will, I think, enable the reader to decipher the whole process of etherification as it stands with regard to the glyoxylate, where three molecules of ethylic alcohol are successively drawn into the sphere of chemical reaction. We have already seen that the action of alcohol on bromo-glycolate of silver gives rise to the neutral monobasic glyoxylate of ethyl,—



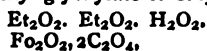
and there is nothing to hinder us from assuming that the same compound is engendered by the action of the first molecule of alcohol on the glyoxylate, while two molecules of water are eliminated. The ether being now in the presence of that element, which is capable of provoking the series of molecular changes I have already indicated, is speedily made to pass into the isomeric modification of the acid bibasic glyoxylate of ethyl,—



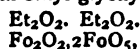
which, with a second molecule of alcohol, may lead to the formation of the neutral glyoxylate of diethyl,—



or else the acid ethyl-glyoxylate of ethyl,—



or, finally, the neutral ethyl-glyoxylate of ethyl,—

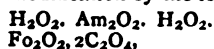


but, whichever way we take it, it becomes certain that the end product of this lengthy and complicated reaction must be the triatomic ethyl-glyoxylate of diethyl, as formulated above.

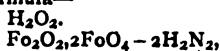
From the preceding explanations the reader will no longer be at a loss to comprehend the true cause of the hitherto unaccountable appearance of acidity on the part of the ammonium glyoxylate while it is being evaporated,—a discrepancy which Mr. Perkin would fain attribute to a want of stability and to its not possessing the character of a true salt, but which is really due to the different positions a particular molecule of hydrogen is destined to occupy in the system, and to the different duties and functions it is thereby made to discharge. Accordingly the neutral or α modification will require to be represented by the formula—



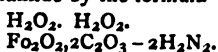
and the acid or β modification by the formula—



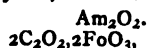
and the same constitutional differences will be traceable in their respective amides, the α glyoxylamide being expressed by the formula—



and the β glyoxylamide by the formula—



Finally, as regards the third isomeride of this group, viz., the ammonium glyoxylate, with the formula—



and which at all events must be regarded as a true ammonium-salt, I can only regret that this interesting compound has not yet received that amount of attention which it assuredly deserves.

In drawing to a close, I may yet be permitted to express an anxious hope that our leading experimentalists may soon condescend to re-investigate this and other kindred problems on the principles and in the spirit of my "Typo-Nucleus" theory,—a task for which these gentlemen are so well qualified, not only in virtue of their superior talents and their exalted professional position, but more particularly on account of the rare practical tact and experience which enables them to cope with the many difficulties that are sure to be encountered in this department of organic chemistry.

ERRATA.—P. 121, line 10 from bottom, for "glyoxalate" read "glyoxylate." Line 14 from bottom, for "bromoglyoxylate" read "bromoglyoxalate."

PROF. DITTMAR AND THE "ANALYST."

PERHAPS some of our readers may have seen in the official organ of the Society of Public Analysts, along with other startling matter, a report of the prosecution of a certain Mr. McKinnon, of Glasgow, for selling adulterated butter, and a leading article commenting in very severe terms upon the evidence of Prof. Dittmar, who was a witness on the trial. This gentleman is made to say that "he did not think Mutter's system was the correct one, and was of opinion that the butter was quite sound." From a letter sent by Prof. Dittmar to the *Glasgow Herald* the report in the *Analyst* seems by no means accurate. He did not pronounce the butter "quite sound," but declared that it was "more likely than not to be contaminated with foreign fat," though he did not feel free to swear to the presence of this impurity. He did not, from any evidence to which we have access, "deliberately prefer old and worthless methods," but merely expressed a doubt—not, in our humble opinion, quite unpardonable—whether the method of Dr. Mutter had as yet been verified by a sufficiently wide experience. In short, it would appear that our contemporary's report goes beyond the facts of the case, and that his leading article goes no less decidedly beyond the report.

We know that there are in connection with the *Analyst* chemists of well-earned reputation, equally anxious for the advance of their science and for the elevation of their profession. To these gentlemen at any rate, if not to the writer of the article in question, we would, in all courtesy, suggest that such attacks as that in the last number of the *Analyst* merely strengthen the hands of the common enemy—those, namely, who consider chemical analysis as altogether untrustworthy, and who regard chemists themselves as either "imbecile," "incompetent," or even as "impostors."

ENAMELLED COOKING VESSELS.

AT the country meeting of the Society of Public Analysts held in Glasgow, during the recent visit of the British Association, a paper was read by Mr. Robert R. Tatlock, F.R.S.E., F.C.S., Glasgow, on "Enamelled Cooking Vessels." He stated that in some instances the milk-white porcelainous enamel, with which cast-iron cooking vessels are now so commonly prepared, is of such a character as to be objectionable in the highest degree on account of the easy action upon it of acid fruits, common salt, and other ordinary dietetic substances, by means of which lead and even arsenic are dissolved out in large quantity during cooking operations. The following analyses were given of three enamels, the samples having been taken from three cast-iron pots made by different manufacturers:—

	No. 1. Per cent.	No. 2. Per cent.	No. 3. Per cent.
Silica	61.00	42.40	42.00
Alumina	8.00	2.88	6.06
Oxide of iron	1.10	2.04	4.04
Lime	3.02	0.16	0.78
Magnesia	0.28	0.10	0.21
Oxide of lead	absent	25.89	18.48
Potash	5.61	7.99	6.46
Soda	20.67	14.67	19.25
Phosphoric acid	trace	trace	trace
Arsenious acid	0.02	0.42	1.02
Carbonic acid	0.30	absent	absent
Borax	absent	3.45	1.70
	100.00	100.00	100.00
Total bases	38.58	53.73	55.28

The author shewed that it was not so much on account of the presence of large proportions of lead and arsenic that the enamels are so objectionable, but because they are so highly basic in their character that they are readily acted upon by feebly acid solutions, the lead and arsenic being thereby easily dissolved out. He showed that the ratio of the bases to the silica in the No. 1 was as 1 to 1·58; in the No. 2 as 1 to 0·79; and in the No. 3 as 1 to 0·76. A 1 per cent solution of citric acid boiled in the No. 1 did not affect it in the slightest, while in the case of the No. 3 the glassy surface of the enamel was at once roughened and destroyed, and lead dissolved out to such an extent as to give immediately a dense black precipitate with sulphuretted hydrogen. He thought that no enamel should be admitted to use unless it was totally unaffected by boiling with a 1 per cent solution of citric acid, which was a very moderate test, and gave it as his opinion that either the use of such poisonous ingredients as lead and arsenic in large quantity should be entirely discontinued, or that the composition otherwise should be of such a character as to ensure that none of the poisonous substances could be dissolved out in the circumstances under which the vessels are used.

ON ANTHRAPURPURIN AND FLAVO-PURPURIN.

By E. SCHUNCK F.R.S., and H. REMER.

IN a former communication we described certain substitution-products of isoanthraflavic acid and anthraflavic acid, to show the difference of these two bodies also in their derivatives. We now describe certain experiments made to ascertain the part which these substances play in the manufacture of alizarin. We may ask how they are formed; whether they pass into alizarin on prolonged reaction with alkali; or, as seems most probable, whether they yield oxidation-products, and consequently purpurins?

We have ascertained that each of the acids yields a purpurin, isoanthraflavic acid forming the anthrapurpurin described by Perkin and anthraflavic acid—a new compound, which we have provisionally named flavopurpurin. The statement of one of us that anthraflavic acid is converted into alizarin on fusion with alkali must therefore be corrected.*

Action of Hydrate of Potassa upon Isoanthraflavic Acid.—If the aqueous solution of the potassic salt of this acid is heated with caustic potassa the originally red colour passes gradually into a violet, and particularly quickly when the temperature approaches the melting-point of potassa. When the intensity of the violet no longer increases the operation is interrupted, the melt dissolved in water and supersaturated with hydrochloric acid. A yellow gelatinous precipitate falls, which is treated with cold baryta water to remove some undecomposed isoanthraflavic acid. The residual lake, on decomposition with hydrochloric acid, yields pure anthrapurpurin, which can be readily obtained in long orange needles by crystallisation from alcohol.

That we have here a trioxyanthraquinon appears from the following analyses:—

	Found.	Calculated for $C_{14}H_8(OH)_2$.
C	65·31	65·62
H	3·28	3·12

The properties are essentially as stated by Perkin.† We shall describe them more fully below, in contrast with those of the new purpurin.

The melting-process works very smoothly, almost the theoretical yield of anthrapurpurin being obtained.

Action of Hydrate of Potassa on Anthraflavic Acid.—This acid is less readily attacked by potassa than the isoacid, and there ensues partial carbonisation. This may be avoided by using a strong potassic-lye under pressure, instead of melting, and consequently employing a lower temperature.

The undecomposed anthraflavic acid is removed by boiling with baryta-water. The flavo-purpurin formed is readily soluble in alcohol, and crystallises in gold-coloured needles.

Analysis shows its composition as $C_{14}H_8O_5$.

	Obtained.	Calculated for $C_{14}H_8O_5$.
C	65·35	65·62
H	3·33	3·12

Properties of Anthrapurpurin. Flavo-purpurin.

Orange needles. Anhydrous. Gold-coloured needles. Anhydrous.

Readily soluble in boiling alcohol. Readily soluble in cold alcohol.

Sparingly soluble in boiling water. Sparingly soluble.

Solution becomes red on prolonged boiling. Solution remains yellow.

Sparingly soluble in ether. Ditto.

Soluble in boiling glacial acetic acid, and crystallises on cooling in stellar groups of needles. Ditto.

Soluble in concentrated sulphuric acid with a red-violet colour.

Soluble in potassa-lye with a violet colour. The tone is redder than that of a solution of alizarin.

Soluble in concentrated sulphuric acid with a reddish brown colour.

Soluble in potassa-lye with a purple colour redder than anthrapurpurin, but not so red as purpurin. On dilution or addition of alkali but slightly diluted the colour appears of a pure red. The colour disappears on standing.

Sparingly soluble in hot baryta water with a violet colour.

The solution shows absorption-bands. Sparingly soluble in hot baryta water with a red-violet colour.

Soluble in ammonia with a violet colour. Solution shows small bands. Absorption-bands in a deep stratum.

Soluble in sodium carbonate with a violet colour. Soluble in sodium carbonate with a yellowish red colour.

Alcoholic lead acetate gives a purple precipitate which dissolves with a violet colour on boiling with excess of the precipitant. Alcoholic lead acetate gives a red-brown precipitate, very sparingly soluble in excess with a red colour.

Alcoholic copper acetate gives a fine violet solution. Alcoholic copper acetate gives a red solution.

Sparingly soluble in alum. Ditto.

Melting-point above 330°. Ditto.

Sublimes in orange needles. Sublimes in long needles resembling alizarin.

Dyes with mordants. Ditto.

Alkaline solution gives two absorption-bands having the same position as those of alizarin. Alkaline solution shows also two bands, but more remote from the red, and also a broad stripe in the blue.

To ascertain whether the above-described reactions might not be modified by small quantities of impurities, we converted both the purpurins into acetyl compounds, re-crystallised them until the

* E. Schunck, *Proc. Lit. and Phil. Soc. Manchester*, 1871, 133.

† Perkin, *Journ. Chem. Soc.*, Ser. II, vol. xi., p. 423.

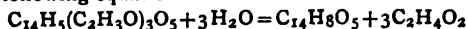
stant, and regenerated the purpurins by means of alcoholic potassa. The reactions remained unaltered.

The identity of the purpurin obtained from isoanthraflavic acid with Perkin's anthrapurpurin we have already established by a comparison of the acetyl-compounds. They have the same properties and the same melting-point.

A determination of the atomic weight gave the following figure:—

Obtained 66.80 per cent anthrapurpurin.

The decomposition of triacetyl-purpurin according to the following equation—



would yield anthrapurpurin = 67.01 per cent. Perkin's conjecture that anthrapurpurin might be formed from isoanthraflavic acid is therefore demonstrated.

Flavo-purpurin is the fourth purpurin known, and is very readily distinguished from the rest by its spectrum.

As to the origin of isoanthraflavic acid and anthraflavic acid, we owe its explanation to a private communication from Herr Caro, of Mannheim, according to which these two bioxyanthraquinons are formed from two distinct bisulphanthraquinonic acids, by the moderated action of alkali. A more powerful action yields respectively anthrapurpurin and flavo-purpurin. Herr Caro has sent us a small specimen of both these sulpho-acids, and we were able to satisfy ourselves that the reaction passes through the following stages exactly according to his description:—

- a. Bisulphanthraquinonic acid.
- Anthraflavic acid.
- Flavo-purpurin.

And on the other hand—

- β. Bisulphanthraquinonic acid.
- Isoanthraflavic acid.
- Anthrapurpurin.

The authors purpose pursuing the subject further.—
Berichte der Deutschen Chemischen Gesellschaft.

CORRESPONDENCE.

ON THE PRESENCE OF ARSENIC IN THE VAPOURS OF BONE MANURE.

To the Editor of the Chemical News.

SIR,—In a recent number of the CHEMICAL NEWS (vol. xxxiv., p. 68) I observed a review of Dr. Adam's paper on the above subject, and I take this opportunity of briefly alluding to one or two points.

Your reviewer's comments on the mutual decomposition of chloride and fluoride of arsenic, &c., by sulphuretted hydrogen, when these compounds are brought together in the gaseous state, have already been disposed of by Dr. Hurter in his able letter in the CHEMICAL NEWS (vol. xxxiv., p. 81), and no further remarks on this point are necessary. For what reason your reviewer should, however, speak of the amount of arsenic evolved in the experiments detailed as being *assumed*, and then go on to suggest the possible presence of that element in the *reagents* employed, is a question which has puzzled me considerably. As regards the incrustation found on the walls of the works referred to in the paper, the amount of arsenic found by two chemists (Prof. E. J. Mills and Mr. "M") is precisely stated, and there is no *assumption* whatever. The figures given are the result of careful analyses. The quantities of arsenic obtained by Prof. Dittmar and myself, in the distillates from mixtures of bones, coprolites, and arsenical acid (the experiments being in imitation of the manufacturing process), do not represent the *total* amount of that element evolved in the process. Owing to the difficulty of completely condensing the vapours, a portion of the arsenic must necessarily have escaped. But they

do represent the amount found by us in the distillates, and the only assumption in this case is that the amount actually volatilised must have been in *excess* of that obtained. I was always under the impression that in examinations for arsenic *chemists* paid special attention to the purity of the reagents employed, but I infer from the remarks of your reviewer that such is not the case—I am, &c.,

JAMES M. MILNE.

Chemical Laboratory,
144, West Regent Street, Glasgow.

[The friends of Dr. Adams appear somewhat sore that his charges against manure works are not at once admitted without further enquiry. The experiments of Dr. Hurter certainly seems to show that sulphuretted hydrogen does not react upon chloride of arsenic in *dry* air, whatever may be the exact relevancy of this important fact. Concerning ammonium sulphide, which Dr. Adams seems to include among the emanations of manure works, no objection has been raised. As to organic miasms, Dr. Hurter's letter supplies not a particle of evidence for doubting their incompatibility with an atmosphere charged with chloride of arsenic, fluorine, &c. As to the main point, the writer of the above letter *even yet* does not state whether the precaution of making "blank experiments" was taken. Surely when such a grave charge is brought against an important manufacture, the public, and especially the interest attacked, have a right to know, not what is usually done by "*chemists*," but what was actually done in this particular case. An author who goes so far as to include carbonic acid amongst the deleterious products of a manufacture has no reason to feel surprised if his statements are jealously scrutinised.—Ed. C. N.]

THERMOCHROMATISM.

To the Editor of the Chemical News.

SIR,—Major Ross, the author of "Pyrology, or Fire Chemistry," is evidently labouring under a mistake when he states in his article on "Thermochromatism, or Heat Colouration" (CHEMICAL NEWS, vol. xxxiv., p. 108), "Mr. Valentin informed me that Mr. Ackroyd was examining my 'ingenious' hypothesis published in that work." And again, on page 109, "Although Mr. Ackroyd has not made the faintest reference to the article on colour in my published work above mentioned, which, according to Mr. Valentin, led to his investigations," &c.

When Major Ross called at the Laboratory in December last, I introduced him to Mr. Ackroyd, who had then, for some months past, been working on colour changes, and had prepared a paper, which he shortly after submitted to the Chemical Society.

I could not possibly have used the words which Major Ross puts into my mouth for the simple reason that neither I nor Mr. Ackroyd had seen what Major Ross is pleased to make me speak of as his "ingenious" hypothesis. For the same reason Major Ross must labour under an erroneous impression when he makes me say, that the article on colour in his "Pyrology" led to Mr. Ackroyd's investigation.—I am, &c.,

WM. VALENTIN.

126, Lancaster Road, Notting Hill, W.

DETERMINATION OF GOLD IN IRON PYRITES.

To the Editor of the Chemical News.

SIR,—Seeing an article by M. H. Schwarz (CHEMICAL NEWS, vol. xxxiv., p. 94) I should be happy if you would allow me to put forward the following suggestions:—After obtaining the mineral that has been fused with the iron turnings, and treating it with dilute sulphuric acid, place it then—after it has been carefully dried—in a crucible (Cornish), with 1½ ladles of pure litharge, 1 ladle of soda-ash and ¼ a ladle of nitre; then mix these fluxes together

within the crucible, and add $\frac{1}{2}$ a ladle of litharge over the whole surface, covering the whole with 1 of dry powdered borax and $1\frac{1}{2}$ ladles common salt. The pot is now placed among the glowing cokes of a Cornish wind-furnace, and carefully allowed to fuse; and when the slag has the bright red wavy fluid appearance, it is taken out, and poured into a mould; first of all 3 parts of the slag is allowed to run out. The pot is then given a twist, to collect any metal that might be hanging to the sides of it; then poured *en masse* into the first. This should be only the work of a few seconds, or else it will all become stiff and pasty, thus preventing it being clearly poured out. It is then turned out from the mould to an iron plate, and allowed to cool, when it is broken. In the centre of the slag should now be found a well-defined button of lead, which should contain all the gold. It is then beaten into a cube, cupelled in the muffle-furnace, which in about half an hour should give a pure piece of gold.

I think this process saves the trouble of roasting, and also of not having to contend with the ferruginous scorice: as it may possibly contain small shots of lead, which decidedly would at once lessen the final result.—I am, &c.,

LATENT.

TRIPOLITE.

To the Editor of the Chemical News.

SIR.—The note by Dr. T. L. Phipson, on the "Tripolite of Barbadoes" reminds me of a deposit of a similar kind which I examined some time ago. It occurs in Lock Oich, one of the chain of lakes forming the Caledonian Canal, and was at one time dredged up in such quantity that it was proposed to be used for improving the land in the neighbourhood. My analysis showed it to be worthless for this purpose, as it consisted almost entirely of siliceous matter, partly fine particles of decomposed rock, and partly the remains of diatoms, most of which I found to belong to well species. Portions of the deposit were perfectly white, and, when dried, extremely light, and constituted a diatomaceous deposit of remarkable purity.—I am, &c.,

W. WALLACE.

Glasgow, September 18, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 7, August 14, 1876.

Thermic Formation of the Two Isomeric Propylic Aldehyde.—M. Berthelot.—The author concludes that the transformation of a normal and primary aldehyd into an isomeric secondary aldehyd liberates either a very small quantity of heat or none at all. He also proposes the following law:—Isomeric bodies, of the same chemical function, are formed from their elements with almost identical disengagements of heat, and the agreement exists also in the formation of their isomeric derivatives.

Thermic Researches on Hydro-sulphurous Acid.—M. Berthelot.—The author explains the greater stability of the ordinary hyposulphites in comparison with this new compound on the principle that, other things being equal, systems are the more stable as they have lost a more considerable portion of their energy.

Hydrated Aluminous Silicate deposited by the Hot Springs of St. Honore (Nièvre).—M. Daubrée.—The composition of this mineral is represented as—

Silica	76.60
Alumina	12.60
Peroxide of iron	2.30
Lime	1.80
Magnesia	traces
Water	6.30

99.60

Influence of Sonorous Vibrations on the Radiometer.—M. J. Jeannel.—I have observed that certain sonorous vibrations determine rotatory movements in the radiometer. With the assistance of MM. Coulier and Alvergnyat I have made various experiments on this subject, which I wish to lay before the Academy:—In a half-dark place three radiometers, A, B, and C, of unequal sensitiveness and perfectly at rest, were placed on the inner surface of a saloon-organ. The low notes, those of the three first octaves, determine movements of rotation. The lowest notes have the greatest action, nevertheless the *fa* and *fa* sharp of the lower octave, especially with the sound of the drone, occasion the most rapid rotation. The *ut*, *re*, and *mi*, although lower, act much less. All the radiometers do not behave in the same manner, either as to the rapidity or the direction of their movements. Thus, under the influence of *fa* or *fa* sharp of the lower octave the radiometer A (the least sensitive to light) revolves at the rate of about one turn per second, with the blackened surface of the discs foremost, that is to say, in the direction opposite to the motion produced by light. The radiometers B and C (more sensitive to light) turned more slowly, and in the direction of the revolution produced by light, that is to say, with the bright side of the discs forwards. I propose to explain these facts as follows:—As certain notes produce no effect, it is evident that the needle, the internal support of the "mill," must be able to vibrate in unison with the notes of the organ if a rotatory motion is to be produced. Certain vibrations of the sounding-board of the organ transmitted to the needle, impart to it circular or angular vibrations, whence results the rotation of the mill which it supports. What appears to demonstrate the soundness of this explanation is that on pressing the end of the finger on the top of the radiometer it is prevented from vibrating, and, at the same time, from revolving. The sounding-board of a piano produces analogous effects, but in a less degree. If we repeat the above experiments in a situation where the diffused light is almost sufficient to set the radiometer in motion, the low notes, even the faintest, occasion rotation in the ordinary direction with the bright surface of the discs forwards. The oscillation produced by passing vehicles suffices. This last result the author explains by the consideration that friction is momentarily overcome by vibration.

Action of Hydracids upon Tellurous Acid.—M. A. Ditte.—The author examines the behaviour of tellurous acid with the hydrobromic, hydrofluoric, and hydriodic acids.

Rhodein from an Analytical Point of View.—M. E. Jacquemin.—In a paper on erythrophenic acid (June 30, 1873), and in a memoir on "Phenol from an Analytical and Toxicological Point of View" (Scientific Congress at Lyons, 1873), it was laid down that if on adding traces of aniline to a liquid a blue colouration was obtained by means of the hypochlorite of soda, the presence of phenol might be inferred in the liquid in question. The author now considers this conclusion as too absolute, but holds that the production of rhodein cannot leave chemists in doubt. If to a certain volume of alcohol diluted with water, to 40° for instance, we add a drop of pure aniline, and then hypochlorite of soda, instead of obtaining the fugitive violet usual in aqueous solutions, we observe a yellowish colouration, passing sometimes into green, and sometimes into a permanent blue-green. If this reaction appears in a liquid which may possibly contain phenol, the presence of that body might be suspected. But to re-

move all doubt, the blue-green liquid, after some time, is diluted with an equal volume of water and a little of a dilute solution of the sulphide of ammonium. If aniline alone has produced the colour there appears the rosy-purple of rhodoin, which finally fades into a yellow. If aniline and phenol are both present, the blue reappears in all its purity, and then also passes into yellow. To distinguish these two yellows, hypochlorite of soda may be added, which in the one case restores the fugitive violet of aniline, and in the other forms the blue erythrophenate, which the next day will be found to have retained its colour.

Researches on the Derivatives of Aceto-valerianic Ether.—M. E. Demarcay.—Not adapted for abstraction.

Examination of Chilian Minerals.—M. Domeyko.—The minerals described are the chloro-iodide of mercury and silver from Caracoles, and polybasic sulphates of copper, often forming a cupro-ferric alum.

No. 8, August 21, 1876.

Thermic Formation of Hydroxylamin or Oxy-ammonia.—M. Berthelot.—Not suitable for abstraction.

An Effect of Lightning during the Storm of August 18th.—M. A. Tréoul.—During the storm which came on in the morning of Friday last, I was occupied between 7 and 8 a.m. in writing at an open window. Heavy peals of thunder, which seemed to fall in the neighbourhood, took place at intervals. During the nearest, and almost simultaneously with them, small luminous columns descended obliquely upon my paper. The length of one of them was about 2 metres, and its greatest breadth $1\frac{1}{2}$ decimetre. It was obtuse at its more remote extremity, it became gradually narrower, and was not more than 3 or 4 centimetres in breadth at the surface of my table. Their appearance was that of ignited gas with imperfectly defined outlines; their colour, not very intense, was yellow, slightly reddish, like that of many flames; but at the surface of the paper, where they hovered for some seconds, they had brighter shades. I did not remark the colour of the lower part of the first colour, but the second presented the bright colours (yellow, green, and blue) of the rainbow; the third was of a very bright blue, fading away almost to whiteness in contact with the paper. There occurred no detonation, only when about to become extinguished they quitted the paper with a slight rustling or hissing comparable to that made by a drop of water thrown upon a hot plate of metal. No odour was perceptible, and the paper was neither stained nor affected. My steel pen was not acted on and I myself felt nothing.

Electric Regulator to Maintain the Movement of the Pendulum.—M. Bourbouze.—This paper requires the accompanying illustration.

Bead Lightning.—M. G. Planté.—The storm which burst over Paris on the morning of August 18 offered an instance of a kind of lightning very rare, not rightly classified by meteorologists, and calculated to throw a new light on the formation of globe lightning. Some flashes were distinctly bifurcated, but one formed as it were a chaplet of brilliant granules, diffused along a narrow luminous band. This flash, which we observed from the heights of Meudon, appeared to strike Paris in the direction of Vaugirard. Similar flashes are described by M. Th. du Moncel as having been observed during a storm at London in the night between the 19th and 20th of June, 1857. They seemed to remain for a few moments, and then seemed as if melted up into granulated light.

Equivalent Substitution of Mineral Matters which enter into the Composition of Animals and Plants.—MM. P. Champion and H. Pellet.—In the ash of the flesh of different animals and of hens' eggs the phosphoric acid is almost constant, as well as the total amount of acid capable of saturating bases. For ashes of different compositions the weight of sulphuric acid saturating the bases is so much the higher as there are more bases of low

equivalents. The ash of veal contains more soda than the ash of beef, and the ash of the eggs of pullets present the same feature if compared with the ash of the eggs of adult hens.

Fermentation of Urine.—M. Ch. Bastian.—A reply to M. Pasteur.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of alkalis and hydrochloric acid. G. W. Hart, Grosvenor Road, South Norwood, Surrey. (Partly a communication from J. Bennet, Michigan, U.S.A.) May 29, 1875.—No. 1976. This Specification describes fusing silica with chloride or sodium on the hearth of a furnace in the presence of hydrogen of vapour of water.

An improved method of and apparatus for the manufacture of gaseous liquids. A. A. Mondolot, Boulevard de Strasbourg, Paris. June 1, 1875.—No. 2001. This consists in an apparatus for the production of carbonic acid gas, whereby lime and sulphuric acid are brought into contact and mechanically agitated, or hydrochloric acid and carbonate of lime or other materials, reacting upon one another without agitation, are mingled in a convenient way.

Improvements in the manufacture of chlorine. H. Deacon, Appleton House, Widnes, Lancaster. June 1, 1875.—No. 2003. The essential feature of this invention, which relates to improvements in the production of chlorine by what is known as Deacon's process, consists in the employment of purifying materials or agents for the purpose of removing sulphuric acid from the hydrochloric acid gas employed in conjunction with heated air, and brought in contact with porous or other substances impregnated with or containing sulphate of copper, or what I have in my former Specifications termed active substances.

Improvements in and in apparatus for the separation of the oily and farinaceous constituents of maize, and in the application of the same for the manufacture of various useful products. A. M. Clark, Chancery Lane, Middlesex. (A communication from L. Chiozza, Paris.) June 1, 1875.—No. 2007. The essential feature of the process consists in operating by means of rolls or screens on the grain, previously treated with a solution of sulphurous acid, and whilst it is undergoing a gradual drying; the process being applicable, with slight variation, to the manufacture of oil, of a white and sweet flour, of dextrin, beer, fermented liquors, vinegar, alcohol, starch, glucose syrup, and glucose.

Improvements in the production of protosulphuret of iron and sulphuretted hydrogen gas for the extraction of copper from mother-liquors, and for other purposes. G. T. Bousfield, Sutton, Surrey. (A communication from the Société Anonyme du Cuivre Français, Paris.) June 3, 1875.—No. 2042. The claims to this complete Specification are the new combination of apparatus and means resulting in a production of sulphuretted hydrogen gas on a large scale, and in a new manufacture which has not hitherto been practically realised, and which is attained by the construction, disposition, and grouping of the apparatus, by heating the acid for the attack before its introduction into the vessels, which hastens the reaction on the protosulphuret, and, in consequence, increases the quantity of gas, which can be disengaged in a given time by the withdrawal of the sulphate of iron at the lower part of the vessel, which permits its extraction even during the production of the gas, and gives the means of drawing off the acid to stop the disengagement of the sulphuretted hydrogen, when desired by employing a helix as a means of stirring. Also the method described for the manufacture of protosulphuret of iron.

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Adulteration of Red Wines.—As the adulteration of red wines with aniline has been brought under our notice by the press, your readers might like to know of some ready means to detect the adulteration; and as I have not seen any very ready means published in your journal, I have taken the liberty of sending you one which I have tried with success. I first take a small quantity of port and precipitate with diacetate of lead and filter, and if the wine be pure it will be quite clear; but if it contains the least trace of aniline the precipitate will be coloured red, according to the amount present. I have tested it myself. Even $\frac{1}{4}$ of a grain to the litre can be seen, because with pure wine it is left quite clear like water if properly done.—A. SMITH.

Will shortly appear, a Second Revised and Augmented Edition of
BUTTER: its ANALYSIS and ADULTERATIONS. By OTTO HERNER and ARTHUR ANGELI, Public Analysts.

F. W. HART, Manufacturer and Dealer in Apparatus and Chemicals for Scientific Pursuits. Laboratory Fitter and Furnisher. Photographic Apparatus and Materials, 8, KINGSLAND GREEN (WEST SIDE), LONDON.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 879.

REPORT ON THE LIMITED OXIDATION OF ESSENTIAL OILS, PART IV.; CONTAINING A PRELIMINARY REPORT ON THE ETHERS.*

(Concluded from p. 128.)

By CHARLES T. KINGZETT, F.C.S., London
and Berlin, &c.

THE following experiments were conducted in order to ascertain to which constituents of my solution the anti-septic and disinfecting character is to be ascribed:—

Camphoric Acid Experiments.

0.3 grm. of the acid in water was sufficient to preserve 400 c.c. milk unaltered for 7 days. After that a scum appeared and a cheesy taste. But it did not go solid and sour till the 11th day.

0.1 grm. camphoric acid kept 50 c.c. of flour paste fresh for 11 days. On the 12th day it became sour.

0.1 grm. camphoric acid preserved 50 c.c. grape juice in a warm oven from fermentation permanently so far as could be observed.

0.1 grm. camphoric acid kept 15 c.c. egg albumen and 10 c.c. water fresh for 21 days. Became mouldy afterwards.

0.1 grm. camphoric acid preserved 200 c.c. bitter beer unaltered for 11 days in an open vessel. It afterwards became covered with fungus.

Peroxide of Hydrogen Experiments.

The strength of the solution used was that of Robbin's 10 volume solution.

10 c.c. preserved 400 c.c. milk for 6 days, meanwhile oxygen was slowly evolved; thick and sour on the 11th day.

5 c.c. preserved 47 c.c. grape must from fermentation for some 24 hours, then bubbles of oxygen were liberated; finally it had an odour like apples.

5 c.c. preserved 15 c.c. albumen (egg)+10 c.c. water fresh for very many days.

5 c.c. preserved 400 c.c. bitter beer unaltered for 26 days; then sour; fungus did not appear.

5 c.c. preserved 30 c.c. flour paste for 6 days; afterwards went bad.

Experiments with Salicylic Acid.

0.1 grm. preserved 100 c.c. bitter beer for 25 days, but gave to it a most peculiar taste—spirituous, bitter sweet. No longer observed.

0.1 grm. preserved 100 c.c. milk for four days. On the 5th it was sour and cheesy, and on the 7th it stunk.

0.1 grm. preserved 50 c.c. flour paste for a number of days, but acquired even on the 4th day a very stale odour.

0.1 grm. preserved 23 c.c. egg albumen, and 12 c.c. water fresh for 4 days. On the 5th it stunk.

These experiments, as also those with camphoric acid and peroxide of hydrogen, were all conducted during October, November, December, 1875.

I will conclude these remarks by pointing out that the solution whose properties have been described has a somewhat bitter but not unpleasant taste; it is non-poisonous, and harmless to clothing and furniture. While its anti-septic power is distributed between the peroxide of hydrogen and camphoric acid, the former of these is able to

evolve large quantities of oxygen, which in this state is nascent and of a powerful oxidising character. Finally, I desire to express my thanks to my friend Dr. H. W. Hake for having rendered me much help during the prosecution of this part of my investigation.

C. I now propose to treat of the more strictly scientific part of my report, and by way of introduction, I may be allowed to state that it has been established by my former researches, that all the members of the terpene family represented by the formula $C_{10}H_{16}$ give peroxide of hydrogen by atmospheric oxidation, and I have further pointed out that this property is undoubtedly related to cymene ($C_{10}H_{14}$) which, as obtained from various sources, also yields peroxide of hydrogen, so that any hydrocarbon containing cymen as a proximate nucleus would presumably give peroxide of hydrogen under suitable treatment. Since my last publication, I have been able through the kindness of Dr. Wright, who placed a small quantity of menthene, $C_{10}H_{18}$, at my disposal, to investigate that body according to the method instituted by me. 18.5 grms. menthene, from solid Japanese camphor, on oxidation in a current of air at a temperature of $60^{\circ}C$., in the presence of 100 c.c. water, gave a solution in which the amount of peroxide of hydrogen was estimated by the iodide of potassium method after forty-four hours, and found to = 0.09114 grm. H_2O_2 . A further amount was produced on continuing the oxidation. Meanwhile the oil grew yellow and thick, but was not further examined on account of the small quantity. The aqueous solution contained also acetic and formic acid, which were identified by the usual tests, and further an oily body which was deposited on concentration. This last body on oxidation with strong nitric acid (1:1) gave a yellow solution which was neutralised by soda, and this solution was found to give a barium salt insoluble in water, and also a precipitate with nitrate of silver. This silver salt on heating deflagrated, was found to contain more than 64.45 per cent silver (a little was perhaps lost). A small quantity of menthene derived from liquid Japan camphor by the action of zinc chloride gave similar results to those above ascribed to menthene from solid Japan camphor.

This limited inquiry exhausted my supply of menthene, nevertheless it supports the conclusion I stated in the third part of these researches (CHEMICAL NEWS, vol. xxxii., p. 138) to the effect that all bodies having cymene as a proximate nucleus give peroxide of hydrogen on oxidation by air. For Dr. C. R. A. Wright has (*Journ. Chem. Soc.*, series 2, vol. xiv., p. 2), by the action of bromine upon menthene succeeded in obtaining a terpene from it in the first place, and on further bromination, cymene. I have also demonstrated that clove terpene, $C_{15}H_{24}$, by the fact that it fails to give peroxide of hydrogen in oxidation, does not contain cymen as a proximate nucleus. And more recently Dr. Wright has supported this statement by showing that clove terpene gives no cymene by the action of bromine. Regarding cymene (paramethylpropyl benzene $C_6H_4(CH_3)(C_3H_7)$) as a hydrocarbon constituted of proximate nuclei, I was led by a study of the subject to consider the possibility of obtaining peroxide of hydrogen by the atmospheric oxidation of suitable compounds containing methyl, propyl, &c. And for the obvious reason that the ethers may in a sense be considered as oxides of the hydrocarbon radicles of the marsh-gas series, I fixed upon them for my first experiments.

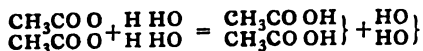
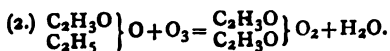
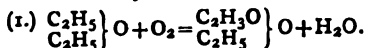
Ordinary ethylic ether has for long been credited with the power of producing ozone, but beyond this, the subject was at the time I commenced my investigation in a similar state of mystery to that which surrounded the so-called formation of ozone by the oxidation of essential oils. That is to say nothing was known about it, beyond that there had been recognised under these conditions a principle which was mistaken for ozone, and of whose production there was no reasonable theory.

I do not propose to relate in detail my experiments, which are necessarily incomplete, but shall only state that ethylic ether gives apparently, by atmospheric oxidation,

* Read before the British Association (Section B.), Glasgow Meeting.

acetic ether and certainly peroxide of hydrogen. This latter I have obtained in estimable amount, but this subject presents great difficulty in working, on account of the volatile nature of the ether chiefly, and most of its compounds and derivatives.

The following equations may possibly represent what occurs when ethylic ether is oxidised in the presence of water in the way I have described.



These equations may be explained as representing—

(1.) The oxidation of ether into acetic ether and water.
(2.) The oxidation of acetic ether into the anhydride, and that into the peroxide.

(3.) The decomposition of the latter with water, simultaneously with its formation.

I believe that we must assume the formation of acetic peroxide, a body which as yet has only been prepared by Brodie by acting on acetic anhydride with barium peroxide.

In my experiments it would appear that ordinary atmospheric oxygen plays the same part as the oxygen of the barium peroxide in Brodie's method.

If this be so, the mode by which the peroxide of hydrogen is assumed to be formed, would give strength to my theory regarding its production from turpentine which may be represented, first as its oxidation into camphor (corresponding to ether); secondly, the oxidation of this body into camphoric anhydride, and the anhydride finally into the peroxide, which is slowly decomposed by water.

I have observed these properties and isolated the products of its change by water, but have not succeeded further.

My method of experiment I hope, at no distant period, to apply to all the ethers available. Meanwhile the preliminary results I have obtained in this new direction already foreshadow a system of classification of the terpene derivatives.

Finally, I submit that the production of peroxide of hydrogen from camphoric peroxide (in the case of turpentine), and acetic peroxide (in the case of ether), amounts to a demonstration of the existence of the radical hydroxyl in compounds, and in a sense may be considered as the isolation of hydroxyl itself.

NOTE ON ANTHRACEN TESTING.*

By J. T. BROWN.

In the earlier days of anthracen manufacture, when it was obtained solely from the last runnings of oil, and when the distillation was stopped comparatively early, for the double reason of saving the bottoms of the stills and producing a good marketable pitch, the principal solid impurities were naphthalen, phenanthren, and paraffin. With samples of this description the method of testing by agitation (after washing with petroleum spirit) with a limited quantity of bisulphide of carbon gives approximate and practically useful results. When, however, the demand for anthracen increased, the tar distillers commenced to continue the distillation as far as possible, and only to stop the operation just before the point at which coking begins. This method of working gives some entirely different samples of crude anthracen, viz., those in which

the principal solid impurities have higher boiling-points than anthracen. Then bisulphide of carbon fails to remove; that test, therefore, with these samples ceases to give correct indications of their commercial value. To correct this the anthrachinon test was introduced, and was, judging from the terms in which it was proposed, looked upon as applicable to all commercial anthracens. The appendix which soon followed showed that experience had not confirmed those anticipations, and now the kinone produced requires to be tested as to its purity, seeing that the resulting product is by no means definite. In applying the kinone test to commercial samples various minor difficulties occur, one of which is that damp samples of anthracen are apt to lose moisture during the time that is occupied in reducing them to a sufficient degree of fineness to allow the small quantity of 1 grm. to be a correct sample of the bulk, and another and more serious one is the uncertainty caused by the occasional occurrence of accidental impurities in the quantity weighed out. To remedy these defects, and facilitate the testing, I should propose the following modification:—

Weigh out 50 grms. of the crude anthracen, and measure out 250 c.c. of petroleum spirit; triturate the anthracen in a mortar with a sufficient quantity of the spirit to form a thin cream, and pour it into a weighed filter (taking care at the same time to leave in the mortar any grit or sand which may be present; rinse on to the filter any anthracen which may be round the sides of the mortar, and employ the remainder of the spirit in washing the filter and its contents. Allow them to drain, then fold carefully, press between bibulous paper, dry at about 60° to 80° C., and weigh. Crush to fine powder the contents of the filter, and from that quantity weigh out the gramme required, then proceed in the usual manner with the kinone test and appendix. In calculating the result, allowance must of course be made for the diminution in weight caused by washing the crude sample with petroleum spirit.

I would recommend the preliminary washing because it has the following advantages in addition to those already mentioned:—It yields a dry powder of perfect uniformity, from which it is easy to weigh out a small quantity.

It removes, besides others, the greater part of two important impurities, one of which, paraffin, defies the kinone test, and the other, phenanthren, if present in large quantities, is not completely oxidised under a considerable time. And as the result of the removal beforehand of a large quantity of the impurity the oxidation proceeds more quietly, and the kinone obtained is more crystalline, and freer from chromium compounds.

REPORT OF THE SEWAGE COMMITTEE OF THE BRITISH ASSOCIATION.*

THIS Report was read by Dr. CORFIELD. It narrated the work of the committee during the past year at Breton's Farm, near Romford. During the months of June, July, August, and September little or no nitrogen, as nitrates or nitrites, was found in the effluent water, and from this it might hastily be concluded that for some reason or another the usual amount of oxidation had not gone on the soil; but the fact turns out to be that oxalic acid had been added to the samples (both sewage and effluent water) of these months with the view of preventing oxidation going on in them during and after collection. The true average amount of nitrogen in the sewage was 5.53 parts per 100,000, and the amount of nitrogen calculated to be applied to the farm in the sewage was 30.2525 tons. Of this quantity, 0.1406 ton was collected in the effluent water re-pumped over the farm. It was remarkable how little the true average composition of the sewage differed from the results obtained in previous years, and the committee considered that this circumstance afforded con-

* Read before the British Association, Glasgow Meeting (Section B.)

* Read before the British Association, Glasgow Meeting. (Section B.)

siderable proof of the accuracy of their methods of sampling, the principle of which had always been that the samples should be taken in proportion to the amount of flow at the time. Thus the amount of nitrogen in parts per 100,000 in the sewage had been, according to the calculations from the results of the gauging and analyses, as follows:—

1871—72	.. .. .	5'529
1872—73	.. .. .	5'151
1873—74	.. .. .	.. not taken
1874—75	.. .. .	5'560
1875—76	.. .. .	5'530

The rainfall in 1872-3 was excessive, which accounted for the small proportion of nitrogen, and with regard to 1874-5 the number given was the result of a single analysis of all the monthly samples taken in quantities proportionate to the amounts of sewage distributed each month. Experiments made with bottled sewage and effluent water (kept for some time) showed that the total amount of nitrogen in the solid matter was not altered by keeping. The nitrogen in the effluent water was almost all converted into nitrates. This applied to filled bottles. In the case of unfilled bottles, a large quantity of the nitrogen in the sewage was lost, while in the effluent water it was only slightly diminished in amount, but was almost all oxidised to the condition of nitrates. Regarding the produce of the farm, the report stated that three plots of Italian ryegrass yielded respectively 58, 53, and 48 tons per acre. The highest average of mangold crops had been nearly 47 tons per acre. The nitrogen recovered in the crops was 20,558 lbs., equivalent to 30·34 per cent of that received in the sewage. Dr. Corfield concluded by stating that the lease of the farm being now up, and as another field of operations had not yet been obtained, the committee did not in the meantime ask to be re-appointed.

Mr. E. C. C. STANFORD said he was sorry that the report of the Sewage Committee had developed very much into a mere report on irrigation. The committee had done valuable work, no doubt, but they had not treated this subject of sewage in the broad way to which it was entitled, and the result was that no question had been thoroughly sifted, save that of Mr. Hope's farm. Even in connection with that the committee had left out what sewage reformers wanted most to know, namely, the balance-sheet.

Dr. GILBERT said he thought it would be found that, in the earlier years of the committee's work, they had investigated other processes besides that of irrigation, and had reported upon them, though, for substantial reasons, investigation was not followed up. Mr. Stanford had lamented the absence of a balance-sheet in connection with the report on Mr. Hope's farm. In reply to that he was quite free to admit that there had been a loss on the working, but his clear opinion was that, loss or not, the country ought to resort to irrigation.

Mr. SPENCE said it had come to be a question between precipitation and irrigation, and the latter was nearly impracticable in the case of very large towns. His conviction was that precipitation by sulphates was the only true solution.

Mr. W. R. W. SMITH had no doubt that for large towns irrigation was simply impossible. Five or six years ago, when the Rivers Pollution Commissioners said there was nothing for it but to irrigate, he told them he would make the prediction that no man then alive would ever see irrigation adopted in Glasgow. He took Dr. Chalmers Morton's figures, and calculated from these that it would require 20 square miles for the production of grass, and that it would take all the cattle in the three counties of Lanark, Renfrew, and Dumbarton to eat that grass; or, if they grew other crops, it would require 120 miles of land. Now, where were they to get such a space of ground for irrigation purposes? With regard to Mr. Coleman's paper (CHEMICAL NEWS, vol. xxxiv., p. 125), he had seen that gentleman's experiments and

considered them very satisfactory. It was urged against it that the manurial produce was not worth much, but here in Glasgow they were able to sell the veriest rubbish of city manure at a good price, and surely there could be no difficulty in selling a better quality. From what he had seen of Mr. Coleman's process, and of the ABC process, he had come clearly to the conclusion that very much could be done by using the cheap charcoal which lay in such abundance at our doors. But we must get rid of adopting a general principle to every particular case, and rather consider all the individual circumstances which would make it easy or difficult to deal with the sewage of a town. Much might be done too by getting the large public works to adopt the most available methods.

Some further discussion followed, in the course of which the Lord Provost asked if the Sewage Committee would explain how irrigation could be adopted in the case of such a city as Glasgow, where there was a vast population, and where land in the neighbourhood was scarce and out of level with the town.

Dr. GILBERT replied that no doubt an enormous quantity of land would be required in the case of Glasgow, but a mixed system of irrigation and filtration through soil might be adopted.

ON A NEW CHEMICAL TEST FOR ALCOHOL.

By EDMUND W. DAVY, A.M., M.D., Professor of Forensic Medicine, Royal College of Surgeons, Ireland, &c.

WHILST making lately some experiments on molybdic acid, I observed that when a solution of that substance in strong sulphuric acid was brought in contact with alcohol, there is very quickly developed a deep azure blue colouration; and this fact, being (as far as I was able to ascertain) hitherto unrecorded, led me to investigate the reaction to determine the cause of this production of colour.

As I found that the protosulphate of iron, and the protochloride of tin, two powerful deoxidising salts, produced a similar effect on this solution, there was but little doubt that it was due to the deoxidising action of alcohol on the molybdic acid. And I afterwards found that the blue substance which was formed in the case of alcohol possessed all the characters of the blue compound which is produced when molybdic acid or its salts are acted on by different reducing agents, whereby a substance consisting of five atoms of the metal molybdenum with fourteen of oxygen is obtained, which is usually regarded as a combination of the binoxide of molybdenum with molybdic acid, the following formula ($\text{MoO}_{2.4}\text{MoO}_3$) representing its composition.

With certain precautions, which I shall presently point out, I have found that this reaction of alcohol on the molybdic solution stated is extremely sensitive, so that by its indications very minute quantities of alcohol, even when diluted with large proportions of water, may be readily detected. Thus, for example, if one part by volume of commercial rectified spirits be mixed with 100 parts of distilled water, and one small drop of this mixture be taken, the minute quantity of spirit contained in it can be easily detected by the deep blue colouration which will be immediately developed on bringing it into contact with the molybdic solution, employed in the manner about to be described. But this is not the limit of the delicacy of this test, for I have been able by means of it to detect the spirit in one drop of a mixture of distilled water and anhydrous spirit, in which the latter substance constituted only the one-thousandth part of its volume; and as the drop was found to weigh 6·10ths of a grain, the quantity of real or anhydrous alcohol contained in it would be less than the 1·1666th part of a grain of that substance.

Though small quantities of spirit, even when considerably diluted with water, will produce with the molybdc solution the blue reaction without the assistance of any external heat, still, where very minute quantities, diluted with such large proportions of water as those just stated, are to be detected, it is necessary, for the success of the experiment, that the reaction should be assisted by a gentle heat, and also that too great a dilution of the test solution with the liquid under examination should be avoided, as the blue colouration will not be developed if water be in excess; and even after it has been produced, the addition of a certain proportion of that substance quickly causes its disappearance. Such being the case, the best way of employing the test, according to my experience, is to place three or four drops of the molybdc solution in a small white porcelain capsule, and having heated them slightly, allow one or two drops of the liquid to be examined to glide or fall gently on the acid solution, when there will be developed, either immediately or after a few moments, the blue colouration. And where the alcohol is very largely diluted with water, it is better to continue the gentle heating of the test solution for some time, to concentrate it or expel as much water from it as possible, before adding the liquid to be tested, for, in this way, I have succeeded in detecting the spirit in mixtures so dilute as to give no blue reaction when added immediately to the test solution on its being simply warmed. As regards the application of heat, I must observe that the temperature of the acid solution must not be raised too high, for if it be heated till the acid evolves its dense vapours, or begins to boil, the solution will of itself alone, from its partial decomposition, develop a more or less blue colouration, which will become more perceptible on its cooling. But such an occurrence can be easily avoided by employing a water-bath as the heating agent; for I have found that a temperature of 212° F. is incapable of so acting on the test solution—at least an exposure of several hours' duration to that heat failed to produce the slightest blue colouration, and a much lower temperature than that suffices for the application of the test.

I should here state that the molybdc or test solution which I have generally employed was made by dissolving at a gentle heat 1 part by weight of molybdc acid in 10 parts of strong and pure sulphuric acid, but the exact strength of this solution as regards the amount of molybdc acid it contains seems to be immaterial.

I may observe that the colouration produced in the reaction stated disappears after a variable interval of exposure to the air—a circumstance which is due, as I have ascertained, to the absorption of moisture from the atmosphere, and not to the re-oxidation of the molybdenum compound, as might have been supposed; for amongst other facts in proof of this, I may state that after it has thus disappeared, it may be readily restored either by expelling the water so absorbed by a gentle heat, or, more slowly, by placing the mixture under a desiccator, and thus removing it by spontaneous evaporation at the ordinary temperature. Such being the case, it is evident that, where the test solution has been too much diluted for the immediate development of the colouration described, expelling the excess of water by heating the mixture on a water-bath, it may be made to exhibit itself.

But the necessity for such evaporation should, if possible, be avoided, which, in most cases, will be so by using only a drop or two of the liquid under examination, and by employing the strongest sulphuric acid in making the test solution; for it is very probable that much of the spirit contained in the liquid would be lost during its evaporation in the water-bath; besides, there would be some risk that the indications of the test might be more or less interfered with from particles of dust or organic matter getting into the mixture during that process.

The reaction which has been described, I should state, is not peculiar to ordinary or ethylic alcohol, but is more or less readily developed by others—at least I found it to be so in the case of methylic, propylic, butylic, and

amylc alcohols, those being the only ones I had for my experiments. But it is more than probable that some at least of the other alcohols may act in a similar manner; however, the reaction is much more rapid and striking in the case of ethylic than in that of any of the other alcohols mentioned. I found also that certain salts of the radicles of those alcohols produced a somewhat similar reaction, as well as ethylic ether and aldehyd, and also several organic matters which are readily susceptible of oxidation.

The circumstance that the reaction described is not peculiar to ethylic alcohol will, no doubt, lessen its value as a positive test for that substance; but a similar objection appertains to all the other known tests for that compound, as their indications are not peculiar to that alcohol alone, if we except, perhaps, Berthelot's test, which is founded on the development of benzoic ether by the action of benzoic chloride, along with caustic potash on ethylic alcohol. But, owing to the trouble attendant on the preparation of benzoic chloride, and some other practical inconveniences connected with the application of that test, it is not likely that it will ever come to be one of very general employment.

The test, however, which I have brought before the Academy has this advantage over those already known, that it far exceeds (according to my experiments) any one of them in point of delicacy. And though the circumstance that the blue reaction produced in the case of this test is not peculiar to ethylic spirit lessens, as before observed, its value for the detection of that substance, this is just what renders the test of more general applicability; for by its aid certain impurities or adulterations may be at once detected in different substances or compounds, which in a state of purity should not contain any matter capable of acting on the molybdc solution employed in this test. I may refer to two important substances as examples, viz., chloroform and chloral hydrate, which are now so extensively employed in medicine and surgery for a number of useful purposes; and being agents of great power, it is of much importance that they should be free from the accidental impurities of imperfect preparation, as well as from the frauds of intentional adulteration, which may either impair their therapeutic value, or even increase the danger of their administration. For there can be but little doubt that in some instances the serious and even fatal effects resulting from their use may, in part at least, have been attributable to the impurities or adulterations of the chloroform, or of the chloral hydrate employed. Now, as I find that neither chloroform nor chloral hydrate, in their pure condition, have any apparent action on the molybdc test, but that many of their usual impurities develop the blue reaction, it affords us a ready means of testing their purity. Thus, as regards chloroform, one of its common impurities is ethylic alcohol, which it may contain either from imperfect preparation, or from fraudulent addition, the very high price of chloroform offering a great temptation to the unscrupulous vendor to increase its bulk or weight by the addition of alcohol, which so readily mixes with it. I have found that the molybdc test at once enables us to detect such an adulteration, even where it occurs in very small proportions in chloroform. Thus, in one experiment, I mixed 1 part of rectified spirit with 100 parts by volume of pure chloroform, and one drop of this mixture being brought in contact with three or four drops of the molybdc solution, previously warmed in a water-bath, gave an immediate deep blue colouration from the spirit contained in it; and, in a second experiment, with a mixture of 1 part of spirit to 1000 parts of chloroform, a single drop of the mixture, being similarly treated, developed a faint blue reaction. Indeed, so searching is this test as regards the purity of chloroform, that I was unable to obtain any sample of that substance in commerce sufficiently pure not to give a blue reaction with the molybdc test, owing to the minute quantities of volatile oils, and other impurities, they contain; and for

my experiments I was obliged to re-purify the commercially pure chloroform to obtain a sample which would give no coloured reaction with my test.

In the case of chloral hydrate, it is stated that one of its usual impurities is the chloral alcoholate (a compound in which alcohol, instead of water, is combined with anhydrous chloral), and that this substance has somewhat different effects on the system from those produced by the hydrate. This compound, owing to the alcohol it contains, gives the blue reaction with the molybdc test, and I have found that where the chloral hydrate contained even so small a proportion of the alcoholate as 1 part in 1000 parts, a little of such a sample being taken indicated its presence when examined by the molybdc test; and it is probable that some of the other impurities which are met with in this important substance may be similarly detected.

Those two examples are sufficient to indicate the use to which this test may be applied in the determination of the purity of different substances used in medicine, as well as in scientific research.

Finally, I would remark that, as the reaction of molybdc acid on ethylic alcohol is so sensitive and prompt in its action, I entertain the hope that there may yet be founded on it, not merely this qualitative test, but likewise a means for the quantitative determination of that important alcohol.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 118.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

Potassium Chlorate.—No important change in the manufacture of the chlorate of potash has been introduced in the last few years. Now, as well as formerly, it is everywhere made according to Liebig's original process, hot milk of lime being saturated with chlorine, and the calcium chlorate, formed simultaneously with calcium chloride, being decomposed by potassium chloride.

In England, which produces the bulk of the chlorate of potash of commerce, it is at present, according to Lunge, obtained in the following manner.†

For saturating the milk of lime are employed two iron cylinders, lined with lead, connected with each other, and fitted with agitators. These cylinders communicate with each other, and with the chlorine still by means of tubes, and in such a manner that the contents of the one approach the state of complete saturation, whilst in the other any chlorine which may have escaped absorption is taken up by fresh milk of lime. As soon as perfect saturation has been attained in the first receiver, its contents are replaced by fresh milk of lime, and the current of chlorine is turned so that it may first enter the second apparatus. The solution of chloride and chlorate of calcium thus obtained has a rose-red colour, due, according to some authorities, to permanganic acid; but which, according to others (Crace-Calvert), appears also in the absence of manganese. In fact, this rose colour of the liquid is observed also as a sign of the complete saturation of the liquid where the chlorine employed is obtained without the use of manganese as at Kunheim's works at Berlin, where chlorine obtained by Deacon's process is used in the preparation of chlorate. The red liquid after clearing with chloride of potassium is evaporated down to

the sp. gr. 1.28 and allowed to crystallise. The liquid drawn off from the first crop of crystals is further evaporated down to 1.35, when a second smaller quantity of chlorate of potash is obtained. A portion, about 12 per cent, of the chlorate of potash remains in the mother-liquor, which can therefore be treated as a source of chlorine. The crystals obtained are still contaminated with chloride of potassium and iron. To remove these impurities the crude salt is dissolved in the smallest possible quantity of hot water, 2.5 kilos. of soda are added to 10 hectolitres of the solution, and after the carbonate of lime and oxide of iron have been deposited it is allowed to crystallise. The crystals are dried in drying-rooms; the larger ones are sold without further treatment, and the smaller ones are ground between rollers. This process, in spite of every care, is sometimes attended with explosions. Lunge therefore recommends to crystallise the salt with constant agitation, and thus obtain it as a crystalline powder. In this manner the purification might also be more readily effected, as easily-soluble salts could be removed from the crystalline powder by merely washing with water.

Whilst considerable quantities of chlorate of potash are manufactured in England this branch seems to be scarcely remunerative in Germany, where the same method of preparation is adopted. Several establishments have recently abandoned the manufacture. According to the experiments of F. Hobrecker, 100 parts of chlorate of potash require—443.10 hydrochloric acid (20° B.); 772.0 manganese (65 per cent); 418.0 lime; 72.7 chloride of potassium (92 per cent; 2262.0 lignite.

Bromine.—However considerably the production of bromine had increased in the earlier decennial periods of its manufacture on the large scale, and however easily vast quantities of this body could be made available for the arts, its industrial applications, and consequently its production, have increased very little in the last few years. Whilst formerly the raw material for its preparation was derived from the mother-liquors of salt springs and from sea-water, especially that of the Dead Sea, which though richly bromiferous is too remote from the centres of consumption for chemical products, a new source has been discovered in the mother-liquors of the clearing salts (Abraum salz) of Stassfurt, which can be easily adapted to the demand. In spite of the quantity of bromine which can be obtained at Stassfurt it is merely a by-product of the potash trade, as, in consequence of the small demand and low commercial value, the cost of production falls little short of the market price. The utilisation of the Stassfurt "abraum" salts as a source of bromine dates from the year 1865, when A. Frank introduced this branch of industry in order the better to compete with the potash from kelp and from salt-springs, and also in the hope of superseding the use of iodine in the manufacture of colours.

(To be continued.)

ON THE

PREPARATION OF SOME COLOURED FIRES (BENGAL LIGHTS) USED IN PYROTECHNY.

By SERGIUS KERN, St. Petersburg.

In preparing coloured fires for fireworks by means of the usual formulæ given in many manuals of pyrotechny it is often very necessary to know the quickness of burning of coloured fires, so as in some cases, as decorations and lances, they must burn slowly, in other cases, as wheels, stars for rockets, and Roman candles, they must burn quicker. Working for some months with many compositions of such kind, I prepared three tables of coloured fires (red, green, and violet), where every formula with a higher number burns quicker than a fire with a lower number. For instance, No. 5 burns quicker than No. 6

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† Lunge, *Dingl. Pol. Journ.*, cxcix., 489.

and slower than No. 4. These tables will, I think, be of much assistance in the preparation of fireworks.

Green-coloured Fires.

No.	Potassium Chlorate. Per cent.	Barium Nitrate. Per cent.	Sulphur. Per cent.
1.	36	40	24
2.	29	48	23
3.	24	53	23
4.	21	57	22
5.	18	60	22
6.	16	62	22
7.	14	64	22
8.	13	66	21
9.	12	67	21
10.	11	68	21
11.	10	69	21
12.	9.5	69.5	21
13.	9	70	21
14.	8.5	70.5	21
15.	8	71	21

Red-coloured Fires.

No.	Potassium Chlorate. Per cent.	Strontium Nitrate. Per cent.	Sulphur. Per cent.	Carbon Powder. Per cent.
1.	40	39	18	3
2.	32	46	19	2
3.	27	51	20	2
4.	23	55	20	2
5.	20	58	20.5	1.5
6.	18	60	21	1
7.	16	61.6	21.2	1.2
8.	15	63	21	1
9.	13	64	22	1
10.	12	65	22	1
11.	11	66	22	1
12.	10	67	22	1
13.	10	67.25	22	0.75
14.	9.25	68	22	0.75
15.	9	68.35	22	0.65

Violet-coloured Fires.

No.	Potassium Chlorate. Per cent.	Calcium Carbonate. Per cent.	Malachite, powdered. Per cent.	Sulphur. Per cent.
1.	52	29	4	15
2.	52	28	5	15
3.	52	26	7	15
4.	52	24	9	15
5.	52	23	10	15
6.	52	21	13	15
7.	51	20	14	15
8.	51	18	16	15
9.	51	16	18	15
10.	51	15	19	15
11.	51	13	21	15
12.	51	11	23	15
13.	51	10	24	15
14.	51	8	26	15
15.	51	6	28	15

PRELIMINARY NOTE ON LITMUS.*

By HOWARD W. MITCHELL.

WARTHA† has separated four organic bodies from litmus. The first is obtained by treating commercial litmus with alcohol of about 90 per cent, filtering cold, and boiling the clear tincture; whereupon indigo is precipitated as a fine powder, according to the author. The second body is

obtained by evaporating the violet-red mother-liquor; it is a beautiful red, or, from many varieties, green, fluorescent substance, indifferent to acids. The litmus residue left after the above treatment with alcohol, and which is insoluble in that fluid, is digested with distilled water for twenty-four hours, after which the deep-coloured solution is evaporated to dryness on the water-bath, the residuary extract treated several times with absolute alcohol containing a little glacial acetic acid and again evaporated, until it forms a brown powdery mass. This brown powder is now extracted with absolute alcohol and acetic acid, whereby a large quantity of a scarlet-red body is dissolved, which resembles orceine and becomes purple-red, in place of blue, with ammonia. The portion of the brown powder insoluble in the acidified absolute alcohol consists of the litmus colouring matter in a state of great purity—so pure, in fact, that by means of it the carbonated alkaline earths contained in spring waters may be titrated with as great delicacy as by the use of cochineal tincture, which is far from being the case with crude litmus.

To get this perfectly pure, it is first washed with absolute alcohol, then dissolved in a small quantity of water and thrown into a large excess of alcohol; the flocculent purple precipitate collected and again thoroughly washed with alcohol.

I have repeated Wartha's experiments as here stated upon some samples of litmus obtained from Bullock and Crenshaw, of Philadelphia, and said to have come from Pettitt, Aimee, and Co., Paris, France. My observations confirm his results in every particular, save as regards the indigo. No deposit of indigo was obtained upon boiling the alcoholic tincture, not even after repeated ebullitions, with intervals of rest and cooling.

The fluorescent body which he mentions is violet or purple, as I have obtained it, and gives a solution in alcohol of a similar colour, which shows a beautiful green fluorescence with sunlight, even when very dilute, and with the spectroscopic gives a very characteristic absorption band in the green, together with an almost total absorption of the violet end of the spectrum.

It is soluble in water, amylic alcohol, and common ether to some extent, extremely soluble in alcohol, but seems to be wholly insoluble in bisulphide of carbon, chloroform, petroleum-naphtha, and oil of turpentine, imparting neither colour nor fluorescent property to those liquids.

The solutions in amylic alcohol and in ether both exhibit a beautiful fluorescence, but the ethereal solution shows the absorption band in the green only very faintly, even when the solution is thoroughly saturated. The solubility of the substance in both of these liquids is probably due to the trace of common alcohol, which they both contain, as found commercially. The body which resembles orceine shows a very faint fluorescence, and in alcoholic solution gives a spectrum in which the absorption is characteristic, and quite distinct from that of the last. It is slightly soluble in water, very soluble in alcohol, but seems to be insoluble in ether, chloroform, bisulphide of carbon, and petroleum-naphtha.

The pure colouring matter proper of litmus is insoluble in alcohol ether, chloroform, bisulphide of carbon, and petroleum-naphtha, both in the cold and upon boiling; it is very soluble in water, and its aqueous solution yields an absorption spectrum differing from that of each of the preceding substances.

This substance turns blue with ammonia, and seems more like the azolitmine of Kane than either of the other substances, but I obtained no ammonia from it by heating with sodic or calcic hydrates, that is, sufficient to show its presence by odour or by reaction upon reddened litmus paper.

It yields in alkaline solution a beautiful violet lake with alumina, one of a pale violet colour with stannous acetate, and deep blue lakes with calcium and barium.

The residue left, after extracting litmus with alcohol and then with water, is soluble to the extent of 8r

* Read before the American Chemical Society, June 1, 1876.

† Ueber den Lakmusfarbstoff. V. Wartha, *Ber. Chem. Ges. Berlin*, 9, 217.

cent in dilute hydrochloric acid, and the portion dissolved in this liquid consists of calcic and magnesian carbonates, free from colouring matter, in the proportions of about 90 per cent and 10 per cent of the carbonates respectively. The residue, insoluble in dilute hydrochloric acid, consists mostly of fine sand, but yields some colouring matter to strong ammoniac hydrate, and forms a solution of a blue colour, with a precipitate, red and gelatinous, somewhat like alumina, upon supersaturation with an acid.

About 25 grs. of the pure colouring matter, 15 grs. of the body like orceine, and 10 grs. of the fluorescent body, were obtained per ounce of litmus.

Diagrams of the absorption spectra yielded by these several substances I reserve for a second paper.—*American Chemist*.

NOTES ON MINERAL ANALYSES.

By W. M. HUTCHINGS.

The accompanying analyses of chrysocolla and copper-pitchblende (*Kupferpecherz*) may prove of interest to some of the mineralogical readers of the *CHEMICAL NEWS*.

The minerals are from Mexico and are imported into England in considerable quantity for copper smelting. The specimens analysed were very pure and homogeneous pieces, sought out from among a large quantity of freshly broken lumps of ore. The two minerals occur so thoroughly intermixed that it is difficult to find a piece of any size of either of them free from the other; so that it was necessary to break up the best pieces into fragments, picking out with forceps those which were perfectly pure of either kind.

The chrysocolla is light bluish green in colour; hardness, 4.0. The copper-pitchblende is dark brown—almost black—with hardness 6.0. Large amounts of gypsum and clay occur with this ore. Copper carbonates are only present in small quantity here and there. When large lumps are broken open they often show drusy cavities in which the chrysocolla occurs botryoidal. This botryoidal chrysocolla is always coated over with a thin layer of quartz—sometimes amorphous, but more usually beautifully crystallised in very minute crystals.

The powdered minerals were dried at 95° C. for some hours previous to analysis.

Analysis of Chrysocolla.

	Per cent.
Silica, soluble in Na_2CO_3 ..	62.42
Silica, insoluble in Na_2CO_3 ..	3.83
Copper oxide	25.69
Lead oxide	0.12
Ferric oxide	0.26
Zinc oxide	0.34
Lime	0.74
Magnesia	1.06
Water	6.13

100.59

With traces of cobalt and manganese.

Analysis of Copper-pitchblende.

	Per cent.
Silica, soluble in Na_2CO_3 ..	20.63
Silica, insoluble in Na_2CO_3 ..	7.35
Copper oxide	28.59
Lead oxide	0.41
Ferric oxide	10.94
Alumina	0.15
Manganous oxide	17.53
Oxygen	3.60
Cobalt oxide	0.35
Zinc oxide	1.54
Lime	0.92
Water	8.30

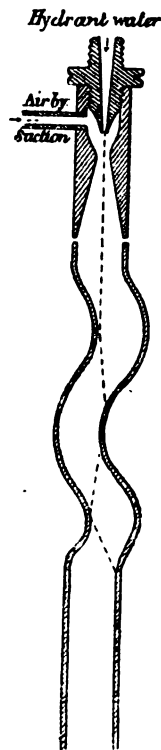
100.31

Laboratory, Wallasey Ore Yard,
Birkenhead

AN IMPROVED FORM OF ASPIRATOR.

By R. H. RICHARDS.

THE arrangement of this improved form of aspirator is shown in the figure.



A glass tube should be bent of the form represented. This is essential, as it serves to break up the water jet into foam and thus start the suction.

I find a hydrant pressure of about 20 pounds on the square inch, equivalent to 40 or 50 feet column of water, will easily exhaust to within 1 m.m. of the tension of aqueous vapour, and will cause a flask of water to effervesce as the dissolved air is disengaged.

NOTICES OF BOOKS.

Massachusetts Institute of Technology. President's Report for the Year ending September, 30, 1875.

THIS establishment continues to be efficiently and successfully conducted. Turning, as a matter of course, to the "Department of Chemistry," we learn that "in the laboratories for quantitative analysis there has been a large and enthusiastic class," and that "the quality of the work done has, as a rule, been good." A variety of improvements and additions have been made. Thus "a careful selection of substances, the analysis of which would give an appropriate analytical training for any branch of chemistry, has now been made." Extra balances have been procured, Bunsen pumps have been replaced by Richard's "jet aspirators," and a modification of the same arrangement is used to supply air to the blast-lamps. The facilities for organic and volumetric analysis, and for the determination of copper in ores

alloys by means of electro-deposition, have been extended. A small room has been set aside for chemico-optical work, and fitted with a large reflecting goniometer, a Landolt's optical circle, a Browning's spectrometer, a large direct vision spectroscopy by Zeiss, a large inverted microscope, a smaller microscope, and three dissecting microscopes by Zeiss and Toller, and a saccharimeter by Soleil.

It may be interesting to the heads of colleges and scientific institutions in this country to note the list of desiderata which Prof. Wing still considers needful before the chemical department of the Institute can be pronounced satisfactorily provided for:—

"The instruction in chemistry is much hampered by the want of a laboratory for qualitative analysis apart from the laboratory used for instruction in general chemistry; of a laboratory for organic chemistry; of a laboratory for applied chemistry; of a suitable reading room where the books of the chemical library may be consulted and writing done; of a number of small rooms for the use of special apparatus."

We regret to learn from a foot-note that the balance-room with its contents and the collection of substances for analysis have been destroyed by fire, and the library very much damaged. We have no doubt that many chemists in this country who have on hand substances of known composition would be happy to assist in restoring the lost collection if some channel were pointed out.

Amongst the theses presented by graduates, we find only one which can be pronounced strictly chemical, i.e., a paper on "Anthracen Pressings," by L. P. Kinnicutt. The subject is highly interesting, but the abstract given is so exceedingly brief that no opinion can be formed as to the merits of the essay.

It must be remembered that in addition to the chemical department, or as we would rather say, faculty, chemistry forms a feature more or less prominent in the courses of mining, engineering, metallurgy, physics, natural history, and general science. Five professors and as many assistants are occupied with various phases of our science.

As a novelty we may point out the introduction of "military science and tactics" as a regular feature in all the departments. Were any of our English colleges or scientific institutions to take a similar step it would be incontinently stormed, sacked, and burnt to the ground by our advanced humanitarians, who protest even against the introduction of military drill into elementary schools.

The Constants of Nature. Compiled by F. WIGGLESWORTH CLARKE. Washington: Published by the Smithsonian Institution.

We have here a continuation of this valuable series of tables. The first supplement to Part I. is devoted to specific gravities, boiling-points, and melting-points. Part II. is occupied with the specific heats of solids and liquids; whilst No. III. comprises tables of the expansion of solids and liquids by heat. We need not say more than that the undertaking is equally laborious and praiseworthy.

CORRESPONDENCE.

SUSPENSION OF CLAY IN WATER.

To the Editor of the Chemical News.

SIR,—Numerous contributions on this subject to the CHEMICAL NEWS have appeared since mine in 1866, but I do not find anything new in them, with the exception of that by Mr. W. Durham, F.R.S.E., who discovers the fact that alkalis and their carbonates in small quantity prevent the coagulation and precipitation of clay suspended

in water. I consider this as an interesting discovery, and one that may enable us to explain the persistent suspension of clay in what we take as pure water. For instance, the purest water we would take for experiments of this sort contains ammonia, either free or as carbonates. Why not, therefore, suppose that this ammonia forms a compound with the silica of the suspended clay, resembling soap in type of constitution, silica of course corresponding with the fatty portion of such substances. As is well known, all soaps deport themselves like clay with regard to the phenomena under consideration.

I would like to know the deportment of pure water with pure hydrous silicate of alumina in regard to the question under consideration. Clay seems permanently suspended in strong ammonia.—I am, &c.,

WILLIAM SKEY.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 9, August 28, 1876.

Sixth Note on Electric Transmissions through the Soil.—M. Th. du Moncel.—From the experiments described it appears that under the most favourable conditions the resistance of the soil varies from 4 to 5 kilometres of telegraphic wire, and that it is consequently far from being nil, as has been commonly asserted. If wells or other stores of water do not intervene the resistance may be sometimes enormous.

Alcoholic and Acetic Fermentation of the Fruits, Flowers, and Leaves of certain Plants.—S. de Luca.—In close vessels fruits keep for a greater or less length of time, whether in hydrogen or carbonic acid, or in a vacuum, or in a limited quantity of air. In such conditions fruits undergo a slow fermentation, with development of carbonic acid, nitrogen, and, in some cases, hydrogen, and with formation of alcohol and acetic acid without the intervention of any ferment. In closed vessels these phenomena are produced imperfectly on account of the strong pressure produced by the gases evolved. Leaves and flowers behave like fruits in a limited atmosphere, either of carbonic acid, hydrogen, or air, in a vacuum or in sealed vessels.

Moniteur Scientifique, du Dr. Quesneville, August, 1876.

Salicylic Acid in the Milk Trade.—Drs. L. Manetti and G. Muso.—The authors recommend the use of salicylic acid for the preservation of cream in small farms where butter is made only a few times in the week, and for the preservation of butter where there is no convenience for storing it in places at a temperature not higher than 6° to 8° C., as well as to keep it from rancidity when forwarded during the summer season to distant markets.

Researches on Viscous Fermentation.—A. Commaille.—Not suitable for abstraction.

Study on Coffee.—A. Commaille.—The author has endeavoured to ascertain if it is possible to class coffees by analysis, as the brokers, merchants, and experts do by certain outward characteristics or by taste. In this attempt he does not consider that he has been successful.

History of the Manufacture of Turkey-Reds.—Theodore Chateau.—A continuation; unsuitable for abstraction.

Constitution of the Derivatives of Benzin.—M. E. Nolting.—A lengthy treatise, containing a large amount

of hypothetical matter, somewhat *naïvely* ushered in with the confession that "not merely the practical man, but even the theoretical chemist, has difficulty in finding his way across the labyrinth of memoirs and dissertations, and in extricating himself from the chaos of contradictory hypotheses!"

New Class of Colouring Matters.—M. Ch. Lauth.—The raw materials employed for obtaining these new products are the aromatic diamines obtained on reducing the nitro-derivative from the acetylation of organic bases. Thus, taking aniline for an instance, acetanilide is first prepared, then nitracetanilide and nitraniline; then the nitraniline is reduced either by iron and acetic acid, or by tin and hydrochloric acid. In the first case it is necessary, when the reaction is completed, to add to the mixture an excess of lime and to distil, obtaining thus β -phenylen-diamine, which a single rectification yields perfectly pure; in the second case we obtain a liquid, from which the tin is removed by zinc, and this mixture may serve at once for the production of the colouring matter, as will be at once explained. The various isomeric diamines have been studied for a long time with the object of turning them to account in the production of colouring matters: the aniline-brown obtained by the action of nitrous acid upon α -phenylen-diamine is the only interesting product hitherto obtained. We arrive at different results if we begin by introducing into the β -phenylen-diamine a new element, sulphur. This β -phenylen-diamine may be obtained by heating the diamine with its own weight of sulphur to 150° to 180° , when an abundant escape of sulphuretted hydrogen occurs. When the reaction is at an end, the mass is treated with hot dilute hydrochloric acid, and filtered to remove excess of sulphur. The liquid thus obtained gives splendid violet-blue colours with oxidising agents. It is, perhaps, more advantageous, and certainly more expeditious, to produce the sulphuration and oxidation in a single operation. For this purpose the hydrochloric solution of the phenylen-diamine is saturated with sulphuretted hydrogen (and we may, in this case, utilise directly the liquid containing zinc mentioned above), and we add perchloride of iron; the sulphur liberated combines in the nascent state with the base, and if the addition of the oxidiser is continued little by little the colouring matter is developed and precipitated. It is filtered, washed with slightly saline water to eliminate certain impurities, dissolved in boiling water, and let cool, when it is obtained pure in splendid crystals. The following are the proportions employed:—To 20 grms. of hydrochlorate of phenylen-diamine—Water saturated with sulphuretted hydrogen, 4000 c.c.; hydrochloric acid, 20 grms.; perchloride of iron in solution at one-tenth, 500 c.c. The new violet is a beautiful dye, giving very pure shades, much more blue than can be obtained with Paris violet of the bluest quality, and it preserves its special tone by artificial light. It is very soluble in boiling water, but the smallest trace of foreign matter modifies its solubility. The alcoholic solution is redder than that in water, and is dichroic. The solution in alcoholic soda is of a splendid magenta-red. Soda added to the solution of the violet gives a brown precipitate, the base of the new colouring matter; ammonia and acids give a violet precipitate, soluble in an excess of acid. The acetic solution is violet; that in mineral acids a fine pure blue; on dilution with water it is re-precipitated. Metallic salts give precipitates which re-dissolve when the salt has been eliminated by washing; chloride of zinc gives a very bulky amaranth-red precipitate; chloride of sodium separates the violet from its solutions, but converts it partially into a new violet substance insoluble in water. If this precipitation is several times repeated the transformation is complete, and the soluble colouring matter disappears entirely. Boiling with salt water gives rise to the same reaction. Tannin forms with the violet a compound insoluble in water. Reducing agents completely decolourise the solutions of this dye, but the colour returns on exposure to the air. Oxidising agents also

destroy it rapidly. The new colour, like most of its congeners, is capable of yielding other colouring matters by substitution; if heated with aniline it yields a blue soluble in alcohol, but insoluble in water; if submitted to the action of aldehyd, iodide of methyl, &c., under ordinary conditions it is transformed into blues of a more and more green tone, but of great purity, and which present the remarkable feature that they are soluble in water, and may be fixed in dyeing by merely immersing the fibre. The colouring matter just described has been obtained with β -phenylen-diamine; if we set out from pseudo-toluydin we obtain a violet much redder, and crystalline toluydin yields a violet-red. It is very probable that in the same circumstances other organic bases will likewise produce colouring matters. Sulphur, then, may play a part in the formation of colouring matters, and as it is permissible to suppose that other simple bodies possess analogous properties, the field of research is indefinitely extended.

Ferments and Fermentations.—M. Charles Blondeau.—Unsuitable for abstraction.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 16, August 17, 1876.

Soap obtained directly from Salt.—If tallow, oil, and resin, the matters commonly employed in soap-making, are heated with an excess of common salt, ammonia, and water, a soda-soap separates, leaving in the liquid chloride of ammonium along with the excess of free ammonia and salt. This reaction is due to the greater solubility of ammoniacal soap in ammoniacal water, and the insolubility of soda-soap in water containing $\frac{1}{4}$ per cent of salt. At first the ammonia combines with the fatty acids, then the sodium contained in the salt takes the place of the ammonia in the soap. An excess of ammonia and soap is essential. 100 parts of tallow require 15 or 20 parts of ammonia, 20 to 30 of salt, and 200 to 300 parts of water (Whitelaw in *Chemischen Centralblatt*).

No. 17, August 24, 1876.

A fall of meteoric stones took place near Stållälen, in Sweden, June 28, between 11 and 12 a.m. Twelve fragments have been found, one of which weighs $4\frac{1}{2}$ lbs. A spectator affirms that a very intense whistling was heard, accompanied by a light which was very distinct, though the day was clear and cloudless. Two very loud explosions were heard, succeeded by one less violent, after which eight or ten persons saw the meteorites fall.

The Radiometer of Mr. Crookes.—A memoir read before the Academy of Padua by Prof. F. Rosetti.—The author concludes his paper as follows:—"After the exhibition which I have performed you will be convinced that the radiometer is not an instrument destined merely to attract general attention by reason of its novelty and the curious phenomena which it presents, but that it may serve as a prompt and sensitive thermometer, and, if used with proper precautions, also as a photometer. It is a novel acquisition for science, both from a theoretical and a practical point of view, and as such it is capable of many applications." The author then describes a modification of the instrument for the purpose of registering the intensity of the solar radiations.

Movements Produced by Light and Heat, and on the Radiometer of Mr. Crookes.—Dr. A. G. Bartoli.—A luminous or thermic pencil which falls upon any body produces a movement due to four causes—(1) Action of the heated sides. (2) Currents of air produced around the heated body itself. (3) Reaction of gases or vapours liberated by heat. (4) Reaction of air heated by contact with the surface upon which the rays fall. On suppressing these causes in the best possible manner, incident light was no longer found to produce attraction or repulsion. These results, however, do not prove that a very feeble impulsive action is not exerted by heat or light.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 33, September, 1876.

Report Presented by M. F. Le Blanc on behalf of the Committee of Chemical Arts on a New Apparatus for the Condensation of Liquefiable Matters Held in Suspension in Gases or Vapours.—MM. E. Pelouze and P. Audoin.—This apparatus cannot be described in an intelligible manner without the aid of illustrations. (See *Comptes Rendus*, lxxvii., pp. 819 and 928.)

Report Presented by M. F. Le Blanc on behalf of the Committee of Chemical Arts on a New Spectro-Electric Tube or "Fulgurator."—MM. B. Delachanal and A. Mermet.—This interesting paper also cannot be made intelligible without the two accompanying illustrations.

Extraction of Vanillin from the Sap of the Pine.—M. Bouquet de la Grye, on presenting to the Agricultural Society of France two samples of vanillin derived from the sap of the pine, made the following remarks:—One of the samples is vanillin in a pure state, whilst the other is prepared for the uses of the confectioner. Vanillin exists in the sap of the pine (*Pinus sylvestris*) and of the larch. The first attempts at its extraction were made by Hofmann, but on a small scale. The price of vanillin, though high, in consequence of the operations necessary for its extraction and purification, is still lower than that of natural vanilla. The difficulty lies in procuring the sap. For this purpose the trees are felled during the period when vegetation is most active—in May and June—and stripped of their bark. They are then immediately scraped. The product of this operation, collected in vessels of tinned iron, is immediately heated on the spot to prevent fermentation, filtered, concentrated, and allowed to cool and settle. A substance is thus obtained which resembles powdered sugar, and which is known as coniferin. This is a stable compound, and is sent in barrels to Paris, where the vanillin is extracted.

Gazzetta Chimica Italiana.

Anno vi., 1876, Fasc. v. and vi.

Inactive Amylic Alcohol of Fermentation.—Luigi Balbiano.—The author describes sulphamyllic acid, and the sulphamylate of baryta, inactive amylic alcohol, inactive amylic chloride, bromide, acetate, and valerate, and inactive valerianic acid.

Alkaloid found in Damaged Indian Corn and in Mouldy Maize Bread.—Prof. T. Brugnatelli and Dr. E. Zenoni.—The authors consider that the alkaloid in question is the cause of the disease known in Lombardy as "pellagra."

Series of Compounds derived from Ammonaldehyd.—R. Schiff.—The author describes the action of ammonaldehyd on phenylic essence of mustard, the formation of acetyl-phenyl-thiosinnamin, the action of ammonaldehyd on the allylic and ethylic essences of mustard. The formulæ given are remarkably sensational.

On Gelatin, considered especially in reference to its Reducing Agency.—Prof. G. Bizio.—This paper is chiefly devoted to an examination of the precipitate produced when gelatin dissolved in water is treated with a solution of mercuric chloride in excess.

Emission of Nascent Hydrogen from Vegetables.—Prof. E. Pollacci.—Not adapted for abstraction.

Action of Certain Reagents on the Principal Organic Colouring Matters.—G. Scurati-Manzoni.—An interesting paper, giving the reactions of colouring matters with certain reagents in a series of tables, too lengthy for insertion.

Natural Poisonous Nature of the Human Corpse.—A. Moriggia.—The cadaveric poison may be extracted from the viscera of a body under toxicological examination by methods used for the alkaloids, and may complicate the result.

MISCELLANEOUS.

Trade Report for September, 1876, of Gehe and Co., of Dresden.—This price current of chemicals and pharmaceutical products is preceded by some very sound and judicious remarks on modern trade and its customs. The authors consider that England has set a good example in its recent legislation on the adulteration of food and drugs, and hopes that there will be a return to genuineness and solidity now the whole civilised world has seen, to its horror, the results of unfettered sophistication.

The Carriage of Explosives.—The British Dynamite Company, Limited, Glasgow, have written letters to the Board of Trade on the above subject. These letters are written as a protest against the conduct of certain railway companies and harbour authorities in refusing to convey or receive for storage any explosive which they may notify that they will not receive. The writer points out that most of the leading railway companies refuse to carry dynamite, and hence its manufacture and use in the United Kingdom is virtually prohibited. He maintains that dynamite, according to the evidence of Major Majendie, "is, on the whole, safer to transport than gunpowder packed in barrels." This refusal to convey dynamite he considers a serious injury to the mining industries of the country, and an obstacle in the way of harbour improvements and other engineering works of public utility. A still greater evil is that there are good grounds for suspecting that dynamite and other explosives are surreptitiously conveyed in passenger trains to a serious extent. It has often struck us as a serious inconsistency that while the sale of poisons is placed under very stringent regulations, that of explosives is practically open. Yet explosives may either by accident or by malice give rise to far more serious calamities than the most malignant poison. We think that the sale of explosives ought to be regulated with great stringency, and that no one ought to be allowed to purchase them without giving proof of his identity, residence, of the purpose for which the substance is required, all these points being registered by the dealer. The custom of miners buying their own gunpowder, guncotton, &c., and storing it in their cottages is most reprehensible, and has given rise to many accidents. Explosives needed in mining should be bought by the employer only, who should be responsible for their safe custody and legitimate employment, and should be served out to the workmen as wanted. In the meantime we are very far from approving of the arbitrary manner in which railway companies refuse to carry certain substances, whilst they convey without scruple goods equally dangerous.

KING'S COLLEGE.—EVENING CLASSES.

WINTER SESSION, 1876-77.

The Evening Lectures commence on Monday, October 9th, and terminate in March.

CHEMISTRY—Mr. W. N. Hartley, at 7 o'clock. Mondays and Thursdays. Fee, £1 11s. 6d.

NATURAL SCIENCE.—Tuesday from 7 to 9. Fee, £2 2s.

St. Mary's Hospital Medical School, OPEN SCHOLARSHIPS AND EXHIBITIONS in NATURAL SCIENCE.

The Examination for 1876 will be held on Tuesday, the 3rd of October, and following days. Candidates are requested to call upon the Dean, at 49, Seymour Street, Portman Square, on the morning of Monday, October 2nd, between the hours of 10 and 1, and to bring with them the necessary certificates.

For further particulars apply to the Registrar, at the Hospital, or to A. B. SHEPHERD, M.B., Dean of the School.

St. Mary's Hospital Medical School, Paddington, W.

OPENING OF WINTER SESSION, October 2nd, 1876.—Introductory Address by Dr. Wiltshire.

SCHOLARSHIPS in Natural Science, Classics, and Mathematics, varying in value from £120 to £200. For further particulars apply to the Dean.

A. B. SHEPHERD, M.B., Dean of the School.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 880.

NOTE ON SOME NEW DERIVATIVES OF ANTHRACEN.*

By W. H. PERKIN, F.R.S.

ANTHRACEN when treated with chlorine or bromine, under ordinary circumstances, yields dichlor- or dibrom-anthracen, even if the hydrocarbon be used in excess. This was shown by Graebe and Liebermann, who found that by treating anthracen under carbon disulphide with only one molecule of bromine, dibrom-anthracen resulted. Dr. Anderson has described, however, a dichloride of anthracen, and also a monochlor-anthracen. There can be no doubt, from the way he produced these bodies, that the first was only ordinary dichlor-anthracen, and the latter I am inclined to believe was a mixture of anthracen and dichlor-anthracen.

I thought under these circumstances it would be of interest to make further experiments on this subject, and see if it were possible to obtain some definite monoderivatives containing chlorine or bromine.

Dibromide of Anthracen.—A one per cent solution of pure anthracen in carbon disulphide cooled to within a degree or two of 0° C. when mixed with the theoretical quantity of bromine dissolved in carbon disulphide, and also cooled with ice, gives a reddish brown fluid, which gradually becomes nearly colourless, and at the same time small white brilliant crystals are deposited: these, when collected, were washed with anhydrous ether, and allowed to dry spontaneously or under the air-pump. They decompose, however, rapidly, and hence good numbers could not be obtained on analysis; but the following combustion, taken in connection with the other facts relating to this substance, shows that it is a dibromide of anthracen.

	Theory for $C_{14}H_{10}Br_2$	Experiment.
Carbon	49.70	48.85
Hydrogen.. .. .	2.95	3.04

Dibromide of anthracen crystallises in flat oblique prisms, which quickly become yellow and opaque at the ordinary temperature with evolution of hydrobromic acid. This decomposition takes place very rapidly if heat be applied. It is difficultly soluble in alcohol, ether, and carbon disulphide. It yields anthraquinon on oxidation.

Monobrom-anthracen.—This substance is formed when the dibromide is kept at the ordinary temperature, or better when it is heated; thus—



Dibrom-anthracen. Monobrom-anthracen.

The fused product is crystallised from alcohol once or twice, and is then pure. It gave the following numbers on analysis:—

	Theory for $C_{14}H_{10}Br$	Experiment.	
		I.	II.
Carbon	65.36	65.37	65.66
Hydrogen	3.50	3.54	3.56

It is also produced by gradually adding the theoretical quantity of bromine to a solution of anthracen in carbon disulphide at the ordinary temperature, and may also be obtained from the mother-liquors from the dibromide of anthracen by distilling off the carbon disulphide and crystallising the residue fractionally; but in both these cases

it is difficult to obtain in a pure condition, as it is usually mixed with anthracen and dibrom-anthracen.

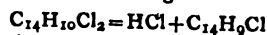
Pure monobrom-anthracen fuses at 100° C. It is easily soluble in benzol and carbon disulphide, and moderately soluble in alcohol, more so than dichlor-anthracen. It also dissolves in glacial acetic acid. It crystallises in long yellow needles. In fuming sulphuric acid it dissolves with a dirty yellowish green colour, addition of water causing a brown precipitate to separate. When its benzoic solution is mixed with a similar solution of picric acid it becomes red, and on evaporation deposits orange-red crystals of the new compound not unlike sublimed alizarin.

Dichloride of Anthracen.—When about the theoretical quantity of chlorine is gradually passed into a one per cent solution of anthracen, cooled to about 0° C., a white crystalline product separates out. This is the dichloride: it is even more unstable than the dibromide, giving off hydrochloric acid rapidly at ordinary temperatures, and still more quickly when heated. It was therefore impossible to analyse it, but from its decomposition into monochlor-anthracen there can be no doubt about its formula being—



This substance is difficultly soluble in alcohol, ether, benzol, acetic acid, and carbon disulphide.

Monochlor-anthracen.—This is best obtained by fusing the dichloride, the reaction being—



Dichloride of anthracen. Monochlor-anthracen.

The product is purified by crystallisation from alcohol, from which it is deposited in golden yellow flat needles, often of considerable length. It may also be obtained from the mother-liquors of the dichloride, which, however, usually contain a good deal of dichlor-anthracen. It gave the following numbers on analysis:—

	Theory for $C_{14}H_9Cl$	Experiment.	
		I.	II.
Carbon	79.05	78.62	78.75
Hydrogen	4.23	4.22	4.52

Monochlor-anthracen fuses at 103° C. It is very easily soluble in ether, benzol, and carbon disulphide. It is also easily soluble in alcohol, and moderately so in glacial acetic acid. It dissolves in fuming sulphuric acid with a green colour: addition of water to this solution gives a brown precipitate, but if the sulphuric solution be heated it turns brown, and is then not precipitated on addition of water, and seems to consist of disulpho-anthraquinonic acid. Like monobrom-anthracen, it produces a compound with picric acid, which crystallises in most beautiful tufts of scarlet needles.

ON THE PROXIMATE COMPOSITION OF COAL-GAS.*

By W. DITTMAR,

Professor of Chemistry in the Andersonian University, Glasgow.

In a memoir, "Sur le Gaz d'Eclairage," which he published some months ago in the *Comptes Rendus*, M. Berthelot reports on a most elaborate proximate analysis of the Paris gas, which brought out the startling result that that gas contained only 3.7 per cent of heavy carburetted hydrogens, and that these 3.7 per cent included of—

Benzol	3.0 to 3.5 per cent.
Acetylen	0.1 "
Ethylen	0.1 to 0.2 "
Propylen and other hydrocarbons	0.02 "

In other words, the gas was found to contain only about $3\frac{1}{2}$ per cent of things *not* diluents, and that these $3\frac{1}{2}$ per cent consisted substantially of benzol only. Regarding the experimental evidence adduced, it may suffice here to state that the sum total of heavy carbides was determined by absorption with bromine, and that the volume of the benzol vapour was identified with the contraction suffered by the gas when shaken with fuming nitric acid.

From the numbers just quoted it would appear that the Paris gas, as analysed by Berthelot, has quite an exceptional composition, owing perhaps to an exceptional mode of manufacture. This, however, is not the view which Berthelot takes of the matter. He does not hesitate to extend his results as applying substantially to *illuminating gas in general*, these results, he says, being in perfect accordance with what he had found out long ago regarding the pyrogenic relations of carburetted hydrogens.

Now it so happened that at the time when Berthelot's memoir reached me I was just engaged in collecting materials and apparatus for investigating, by synthetical methods, into the extent to which the several constituents of a coal-gas contribute to its illuminating power: I accordingly read Berthelot's paper with the greatest possible interest, and at once decided upon looking into the matter.

I will begin by offering some remarks on the manner in which Berthelot tries to account for the fact that all previous coal-gas analysts, instead of his few per milles, invariably found large percentages—sometimes as much as 10 per cent, and even more—of olefines. Berthelot's explanation is this:—Until now analysts (in attempting to determine the composition of their olefines) have entirely relied on the eudiometric method of combustion, and “la traduction de leurs resultats par les noms de . . . est absolument erronée comme repasant sur un simple jeu d'equations algebriques, calculées dans l'hypothèse de certaines inconnues qui ne sont pas conformes à la réalité.” Now this, I think, is putting it rather strongly. It is quite true that gas analysts hitherto have not always kept quite alive to the obvious proposition that the combustion of a gas cannot by any means give us more than the quantitative elementary composition of the unit volume, and that consequently the reporting of so-and-so many per cents of ethylen, butylen, &c., is nothing more than a rather clumsy *modus* of stating the volumes of carbon-vapour and hydrogen in the part condensable by bromine or by fuming oil of vitriol. But it is possible to assume that in the many coal-gas analyses which have been published by Bunsen, Landolt, Frankland, and others, the numbers which to these chemists served as a basis for their calculations should have been so entirely wrong as to enable them to turn into C_nH_m what in reality consisted mainly of C_6H_6 ?

Let us look at an example. Bunsen, in his “Gasometric Methods,” gives all the details of a complete analysis of a sample of Manchester coal-gas, in which his “ethylen” and “ditetryl” (C_4H_8) were calculated from the following data:—(After removal of H_2S and CO_2) 11·1 vols. of the gas gave up to fuming oil of vitriol 0·747 vol. To determine the carbon and hydrogen in this 0·747 vol. two combustions were made, viz., one of the original gas, and, secondly, one of the part not condensable by SO_3 ; and from the result it appeared that the “olefines,” if burned by themselves, would have given—

A contraction of 1·747 vols.
 CO_2 „ 2·089 „

Now these numbers show that, whatever may have been its *proximate* composition, the elementary composition of the “olefine” was $C_{1·05}H_2$ = say 0·75 vol. (which is near enough), and, neglecting the small excess in the carbon, we see that these numbers agree with the hypothesis that the absorbed gas consisted of—

C_2H_6 = 2 vols of propylen, and
 $\frac{1}{3}C_2H_4$ = 1 vol. of ethylen.

It is true there is room for a little benzol. To find a maximum limit for this potential benzol, let us assume the observational errors had made the carbon too high and the hydrogen too low, and take $x = 1·1$ and $y = 1·8$, instead of 1·05 and 2·00 respectively. If we do so we find—

Benzol .. 0·13 vol.
Olefines .. 0·62 „
containing $CO_2 + H_2$ } or $C_{26}H_{4·52}$ in 2 vols.

We see that what was put down by Bunsen as so much of a mixture of C_2H_4 and C_4H_8 could not well be assumed to have contained much above 17 per cent of benzol.

No doubt if we went to the trouble of re-calculating, in a similar manner, the coal-gas analyses executed after Bunsen's method by Frankland, Landolt, &c., we should arrive at similar results. I prefer passing now to a series of experiments which I made for ascertaining to what extent Berthelot's views hold with regard to Glasgow coal-gas.

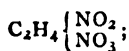
The first experiment I made was to pass a current of the gas through a long column of nitric acid, of 1·5 sp. gr., into a glass gas-holder, and then to compare the illuminating power of the product with that of the original gas, a “fish-tail” burner being used in both cases. The flame of the de-benzolated gas was only very feebly luminous, which, at the time, I felt inclined to accept as strong evidence of the absence in the gas of any considerable quantity of olefines; but not feeling quite sure on this point I tried some experiments on the luminosity of synthetically prepared mixtures of hydrogen and ethylen. To my surprise I found that the addition (to 1 vol. of C_2H_4) of only 3 vols. of hydrogen sufficed to bring down the luminosity to about the level of marsh-gas, while a 10 per cent ethylen flame was no more luminous than that of a Bunsen's lamp! On the other hand, a mixture of *benzol-vapour* and hydrogen, which (by combustion of a measured volume with oxide of copper) had been proved to contain 3 per cent of benzol-vapour (equal in carbon to only 9 per cent of C_2H_4), was found to give a brilliantly luminous flame.

These results render it highly probable that the light-value of a coal-gas depends far more on the proportion of benzol than on the proportion of olefines contained in it. This, however, has nothing to do with the question on hand. More nearly related to it is an observation which I made incidentally in preparations of benzolated hydrogen. The 3 per cent gas above referred to had been made by passing hydrogen slowly through a bulb apparatus charged with benzol, and kept at about 18° C. From the bulb apparatus the gas was made to bubble up through water into a gas-holder. Now, according to Regnault's tension determinations, the gas should have contained about 10 per cent of benzol-vapour, and yet it contained only 3 per cent. I could not explain this otherwise than by supposing that the greater part of the vapour originally present had been dissolved out by the water in the gasometer. To test this hypothesis a quantity of benzolated hydrogen, kept over mercury, and proved by combustion to contain 6 per cent of C_6H_6 , was shaken with water and again analysed. The percentage of benzol-vapour was reduced to less than 2.

After these experiences I felt convinced that, although coal-gas as it comes out of the retort cannot help containing a considerable proportion of benzol, only very little of this vapour will survive the subsequent processes of purification. And having previously found that Glasgow gas when shaken with bromine contracts about 10 per cent, I had no doubt in my mind that the greater part of this contraction must be owing to olefines.

Wishing to determine the exact ratio in the gas between the benzol and the olefines, I tried very hard to find out a quantitative method for their separation from each other; but I did not succeed. That *nitric acid* of 1·5 is *not* the proper reagent for the purpose a few experiments were sufficient to show—some made with pure ethylen, others with synthetically prepared mixtures of this gas with ben-

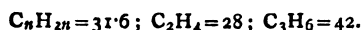
olated hydrogen of known composition. In all cases the acid was found to act on the ethylen as well as on the benzol; no doubt with formation of Kekulé's—



and equally unfavorable results were obtained when r4 acid was substituted for the r5. For a time I thought an approximate separation, at least, could be effected with fatty oils or heavy paraffin-oils, but it turned out an illusion; a considerable quantity of ethylen always accompanied the benzol in its absorption by these liquids.

The last substance I tried was non-vulcanised india-rubber, and, if I may trust a few preliminary trials, it *does* seem to have the power of abstracting the benzol from a gas without condensing much of the ethylen. I have, however, not yet found the time for trying *exact* quantitative experiments.

In order to form an idea of the proximate composition of the olefine portion of Glasgow gas, a current of it was made to pass (1) over dry chloride of calcium, (2) over a coil of sheet india-rubber, and (3) through a long slanting tube charged with bromine. The bromine soon got almost entirely converted into a liquid bromide, which was washed with dilute caustic soda, dried with fused chloride of calcium, and distilled. A *considerable* portion distilled below the boiling-point of propylen bromide (142°). The percentage of bromine was found to be 83.52, whence, assuming the composition to be $\text{C}_n\text{H}_{2n}\text{Br}_2$, we have—



When a weighed quantity was treated on a water-bath with alcoholic potash, a large precipitate separated out, which was found to contain more than half of the bromine originally present in the substance.

These experiments clearly show that the substance consisted substantially, *not* of mono-bromo-benzol ($\text{C}_6\text{H}_5\text{Br}$, which is *not* decomposable by alcoholic potash), but of bromides, $\text{C}_n\text{H}_{2n}\text{Br}_2$, in which the lowest term, $\text{C}_2\text{H}_4\text{Br}_2$, must have been very largely represented.

From the foregoing it is clear that, contrary to Berthelot's assertion, the constitution of the heavy carburetted hydrogen portion in coal-gas is pretty much what it has always been supposed to be.

I have to thank my friend Mr. W. J. Curphey for the excellent manner in which he has assisted me in this little investigation.

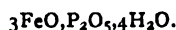
Anderson's University, Glasgow,
September, 1876.

NOTE ON A NEW CORNISH MINERAL.

By FREDERICK FIELD, F.R.S.

MR. TALLING, of Lostwithiel, Cornwall, called my attention to a highly crystallised and very beautiful Cornish mineral which is quite new to mineralogical science. Its crystallisation appears to be rhombic; it is transparent and brilliant, of a clear green colour; hardness about 3.5. It is perfectly soluble in dilute hydrochloric acid, forming a nearly colourless solution. On heating a little over 100° C., the crystals lose water, and at a low red heat at once become brilliantly black. They decrepitate strongly.

Analysis proved the existence of phosphoric acid, ferrous oxide, and water in the proportions that would lead to the formula—



From the great scarcity of the mineral only small quantities can be obtained for analysis, and this brief description must be regarded merely as a preliminary note on a mineral of great beauty and interest.

October 3, 1876.

EVOLUTION OF ANTIMONY FROM STIBNITE BY NASCENT HYDROGEN.

By WILLIAM SKEY,
Analyst to the Geological Survey of New Zealand.

THE fact that Prof. Storer* has based a method for the direct determination of lead in galena upon the deportment of this ore with zinc and hydrochloric acid, discovered by me in 1870†, induced me to further investigate decompositions of this nature, and the results of this show that stibnite, in contact with zinc and hydrochloric acid, instead of evolving HS as when zinc is omitted, evolves HSB only, that is, at least, during the earlier part of the time in which decomposition is going on. Mispickel, in like manner, first gives off HAs.

It will be seen, therefore, that metallic sulphide can be directly tested for either of these metals in the way indicated above, in conjunction, of course, with slips of paper moistened with a lead salt, and other slips moistened with a silver salt.

For experiments of this kind it is best to use the acid weak, the zinc amalgamated, and the ore coarsely crushed

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY

IN THE
LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. V.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

- (1.) *Analysis of the Ash of the Ground-Pea (Arachis hypogaea) as Cultivated in Virginia.* By WILLIAM G. BROWN, of Albemarle Co., Virginia.

The pea-nut, also known by the trivial names ground-pea, gouber-pea, and pinda, is a plant cultivated pretty largely in the south-eastern counties of Virginia, near the sea-coast, and in the adjoining part of North Carolina. The nuts, developed on a slender underground stem, are shipped to various parts of the country and sold to be eaten as a sort of cheap luxury after they have been roasted like chestnuts. In France they are extensively employed in making by expression a fine, bland oil, the supply being brought chiefly, if not solely, from the West Coast of Africa and Algiers. The haulm forms excellent forage for cattle. The oil has been the subject of chemical examination by Goessmann and others, but the only record of any study of the plant itself seems to be that contained in the "Report of the United States Department of Agriculture" for 1870 (p. 92), with the quotation there made from the "Transactions of the Highland and Agricultural Society of Scotland" (vol. vi., p. 556). Dr. Antisell, Chemist to the Department of Agriculture, gives merely the proximate composition of the seed and husk in but a rough sort of way, since albuminoid matter and starch are reported together, and the figures given for seed and husk separately will not agree arithmetically with those for the two together, and puts the ash at 1.77 per cent (seed) and 11.90 per cent (husk); saying only as to its composition, that in the case of the seed it consists of salts wholly soluble in water, being phosphates of the alkalis with traces of alkaline chlorides and sulphates, while the ash of the husk contains, chiefly common salt and phosphates of lime and magnesia. The quoted analysis is by Dr. Anderson, also approximate, and applies to the cake or *marc* after expression of the oil. He gives the amount of ash as 3.29 to 3.78 per cent, and says that it contains 1.14 to 1.17 of phosphates and 0.08 to 0.52 of

* "Select Methods of Analysis," by W. Crookes, F.R.S., p. 214.

† Phil. Trans. of New Zealand Institute, vol. iii., p. 222.

phosphoric acid. A good and complete analysis of the ash of the different parts of the plant seeming to be worth making, Mr. Brown undertook the work with material obtained by the obliging help of Mr. Jos. van Holt Nash, of Petersburg, Va.

The plants were carefully taken from the earth when the nuts were just ripe, and sent to the laboratory as gathered. For analysis the root, stem, leaf, husk, and seed were separated, and all visible traces of adhering sand and clay as fully possible removed by brushing and sifting. The seeds used were only such as had ripened perfectly, all shrivelled or unsound kernels being rejected. The method of analysis adopted was uniformly applied to all the parts. The material, air-dried at 15° to 20° C., was cut into small pieces, and, after weighing, burned in a partially covered porcelain crucible surrounded by one of sheet-iron, the latter serving as an air-bath. The heat was gradually applied, and not allowed to attain redness.

The amount of crude ash so obtained, not entirely free from remains of charcoal, was found as follows:—

TABLE I.

(In 100 parts of Air-dried Substance.)

	Root.	Stem.	Leaves.	Husk.	Seed.
Crude ash ..	6'750	7'915	9'932	1'532	1'721

From one portion of this crude ash, carbon dioxide and chlorine were determined. Another portion was treated with dilute hydrochloric acid and evaporated to dryness over the water-bath to render silica insoluble; the residue treated again with hydrochloric acid, warmed with water, and filtered. The residue on the filter consisted of charcoal, silica, and sand; the first was burned off at a low heat, and the second dissolved out by solution of sodium carbonate. From a portion of the filtrate sulphuric oxide was determined as barium sulphate, and after removing this the alkalies were obtained and separated. Another portion of the filtrate was used to determine ferric oxide (precipitated as phosphate from acetic acid solution), and the liquid left on removing this was divided into two parts—one being used to obtain phosphoric oxide by a solution of uranium, while the other gave lime and magnesia. The following results of analysis were obtained:—

TABLE II.

(In 100 parts of Crude Ash.)

	Root.	Stem.	Leaves.	Husk.	Seed.
K ₂ O ..	14'057	17'069	10'948	23'692	36'380
Na ₂ O ..	11'480	2'019	1'995	2'384	3'274
CaO ..	17'160	28'626	37'027	12'763	3'673
MgO ..	5'311	8'762	3'338	8'557	13'792
Fe ₂ O ₃ ..	2'160	0'770	1'845	1'973	0'512
P ₂ O ₅ ..	2'247	1'048	3'225	3'207	28'511
SO ₃ ..	7'940	6'994	10'503	11'245	11'504
Cl ..	0'708	0'989	1'746	0'308	0'339
SiO ₂ ..	2'260	0'615	0'545	1'269	0'393
CO ₂ ..	17'934	23'893	24'380	26'286	0'868
Sand and charcoal }	18'776	9'432	5'098	8'695	0'963

Deduct O	100'033	100'217	100'650	100'379	100'209
equiv. to	0'160	0'223	0'393	0'069	0'076
Cl ..					

99'873 99'994 100'257 100'310 100'133

The whole of the potassium and sodium having been calculated as oxides, while a part exists combined with chlorine, a deduction of oxygen equivalent to the chlorine present has been made as above.

The large amount of sandy residue in the roots was owing to the difficulty of thoroughly cleaning their knotted and contorted fibres.

Omitting from the above results the CO₂ and insoluble residue, and calculating the thus purified ash to 100 parts, we get—

TABLE III.

(In 100 parts Pure Ash, including Fe₂O₃.)

	Root.	Stem.	Leaves.	Husk.	Seed.
K ₂ O ..	22'255	25'603	15'466	36'265	36'940
Na ₂ O ..	18'174	3'027	2'830	3'740	3'325
CaO ..	27'168	42'938	52'313	19'537	3'731
MgO ..	8'408	13'143	4'717	13'098	14'187
Fe ₂ O ₃ ..	3'420	1'155	2'607	3'020	0'520
P ₂ O ₅ ..	3'558	1'572	4'557	4'909	28'950
SO ₃ ..	12'570	10'491	14'838	17'212	11'681
Cl ..	1'122	1'483	2'467	0'472	0'344
SiO ₂ ..	3'578	0'922	0'771	1'943	0'399

Deduct O	100'253	100'334	100'566	100'196	100'077
equiv. to	0'253	0'334	0'566	0'196	0'077
Cl ..					

100'000 100'000 100'000 100'000 100'000

As the iron may to a considerable extent have come in with the sand as an accidental constituent, the analyses have also been re-calculated, excluding Fe₂O₃—giving the figures in—

TABLE IV.

(In 100 parts Pure Ash, excluding Fe₂O₃.)

	Root.	Stem.	Leaves.	Husk.	Seed.
K ₂ O ..	23'043	25'902	15'880	37'395	37'134
Na ₂ O ..	18'816	3'063	2'897	3'763	3'342
CaO ..	28'130	43'440	53'712	20'145	3'749
MgO ..	8'706	13'296	4'844	13'506	14'262
P ₂ O ₅ ..	3'684	1'590	4'679	5'062	29'102
SO ₃ ..	13'015	10'613	15'235	17'749	11'742
Cl ..	1'162	1'501	2'533	0'486	0'346
SiO ₂ ..	3'705	0'933	0'791	2'003	0'401

Deduct O	100'261	100'338	100'571	100'109	100'078
equiv. to	0'261	0'338	0'571	0'109	0'078
Cl ..					

100'000 100'000 100'000 100'000 100'000

It appears from the above results that after deduction of CO₂ basic constituents predominate over acid in the ash of all parts of the plant, largely so in most; and hence salts of organic acids have to a large extent been destroyed during the combustion. Of inorganic salts the sulphates and phosphates of the alkaline and alkaline-earth metals are the principal—the sulphates being the more abundant in every case except that of the seed. The comparatively small amount of potassium and very large amount of calcium in the leaves is remarkable, as is the unusually large proportion of sodium in the root; this, too, unaccompanied by a corresponding amount of chlorine. Several duplicate determinations were made in the case of the ash of the seed, and these showed as usual that the percentages of the different constituents are subject to a little (but no great) variation; this chiefly extending to the relative proportions of calcium and magnesium, while the united amount was nearly fixed, and to the sulphuric oxide, which, in one instance, fell considerably below the average quantity.

In order to reduce the material examined to a definite condition of dryness, a specimen of each part of the plant was kept at 100° C. as long as it continued to lose weight, with the following results:—

TABLE V.

(In 100 parts Air-dried Substance (as burned.)

	Root.	Stem.	Leaves.	Husk.	Seed.
Moisture lost at 100° C...	9'783	11'484	9'483	9'041	4'892

If, now, the water thus found, together with the sand, charcoal, and carbon dioxide, be deducted from the amount of crude ash, we have,—

TABLE VI.

(In 100 parts dried at 100° C.)

	Root.	Stem.	Leaves.	Husk.	Seed.
Pure ash..	11·830	13·288	7·747	2·586	1·818

Besides thus examining the ash, the percentages of oil and of nitrogen were determined in the seed—the former by repeated and thorough extraction with ether, using atmospheric pressure to force the liquid through a tall percolating tube into a partially exhausted flask, the latter by combustion with soda-lime.

Two specimens of air-dried seed gave 47·34 and 47·44 per cent of oil respectively. This amount is greatly in excess of the figures given in the Agricultural Department's Report above referred to, Dr. Antisell having found only 16 per cent in the Virginia seed, while that of Algerian growth, it is said, on the authority of Dr. Anderson, "furnishes 25 to 27 per cent," to which is probably to be added 6·78 to 12·75 per cent found in the cake.

The nitrogen in the air-dried seed amounted to 3·415 per cent, representing about 22 per cent of albuminoid matter, or nearly the same as in the common pea or bean.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 139.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

WHEN, in consequence of the extensive opening of manufacturing for the utilisation of the "abraum" salts, an over-production of the salts of potash occurred, other establishments felt induced to enter upon the preparation of bromine, but without accomplishing anything worthy of note in this direction.

Rich sources of bromine were also discovered in North America, and have been worked with great success.

The product, however, does not arrive in Europe as liquid bromine, since ships do not generally receive it among their cargo. It is exported chiefly as bromide of potassium. But considerable as is the quantity of bromine produced in North America there is no foundation for the fear that it may occasion any appreciable depression of the Stassfurt trade, since bromine is obtained in America as a main product, whilst in Stassfurt it plays merely the part of a by-product of the potash manufacture.

The demand for bromine and its compounds depends on its applications in medicine, photography, and scientific chemistry. The hope of seeing its hydrocarbon compounds extensively employed in the manufacture of coal-tar colours in place of the corresponding iodides has not been fulfilled, in spite of the present greatly increased price of iodine. One obstacle which stood in the way of the application of brom-ethyl and brom-methyl for the purpose in question, i.e., the great volatility of these compounds, has been overcome by Dr. A. W. Hofmann,† who proposes to cause bromamyl—which boils at the far higher temperature of 120°—to act upon the coloured bases, to be ethylated or methylated simultaneously with methylic or ethylic alcohol, thus forming brom-ethyl or brom-methyl along with amylic alcohol. Still the small

reactive power of the bromides as compared with the iodides, the inferior brilliancy of the colours produced with the aid of the former, the difficulty of recovering the bromine as completely as iodine in consequence of its volatility, have prevented bromine from effectively competing with iodine in this department. Still the hope that bromine may on further investigation attain importance in tinctorial chemistry has not been abandoned. Certain manufactories, both English and German, use a mixture of brom-ethyl, which boils at about the same temperature as iod-methyl and brom-methyl. The reporter is informed on good authority that the colour works of Huddersfield and of Barmen still draw large supplies of bromine from Stassfurt.

The use of bromine as a disinfectant in the form of an aqueous solution, introduced during the North American and Franco-Prussian wars, has remained very limited although it possesses several advantages as compared with chloride of lime. In hospitals the use of bromine occasions much less irritation in the respiratory organs than that of chlorine.

Although, as has been stated, bromine finds scarcely any application in great manufacturing operations, its production is still important, as appears from the report of Chandler.* According to this authority 62,500 kilos were annually obtained in North America alone in 1869 and 1870, principally in Tarentum, Sligo, Natrona, Pomeroy, Ohio, and Kanawha. Stassfurt produced in the year 1873, 20,000 kilos.; and England and France together about the same quantity.

From the foregoing it will be readily inferred that there is little novelty in the methods of extracting bromine.

Leislert† took out an English patent for a method of obtaining bromine and iodine. He decomposes the bromiferous lyes with a mixture of hydrochloric acid and bichromate of potash in an iron still furnished with a capital of lead or stoneware. The vapours of bromine along with water are led into a receiver containing iron turnings. Bromide of iron is formed, which dissolves in the water, and is either converted into other metallic bromides by the customary methods, or is treated for free bromine with sulphuric acid and bichromate of potash. This process has never been reduced into practice, and for Germany at least appears too expensive.

In Stassfurt, therefore,‡ the method has been followed which had been used for the extraction of bromine in the salt works of Schönebeck, Artern, and Neusalz, consisting of the following operations:—The mother-liquor of carnallite at 35° B. freed as far as possible from chloride of calcium by refrigeration, is concentrated to 40° B. by further evaporation. According to Frank the concentration cannot be carried so far, as, in consequence of the partial overheating of the lye at the bottom of the pan, bromine is inevitably wasted in the form of hydrobromic acid. On cooling to 25° a quantity of chloride of magnesium, $MgCl_2 + 6H_2O$, and the remaining mother-liquor contains from 0·3 to 0·5 bromine as bromide of magnesium. It is placed in a sandstone apparatus resembling those used for the preparation of chlorine with the corresponding quantity of manganese and hydrochloric acid, and heated by the introduction of a current of steam. The red vapours which are evolved about a quarter of an hour after the steam is turned on are condensed in a lead worm, cooled in water, and are collected as liquid bromine in Wolff's bottles. The crude bromine is redistilled in glass retorts for further purification. A sandstone apparatus can be charged six times in twenty-four hours. In order to obtain the bromine free from chlorine it is agitated with a solution of bromide of potassium, from which bromine is liberated equivalent to the chlorine present, whilst chlorine of potassium is formed (Falières).

To be continued.)

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

A. W. Hofmann, *Ber. Chem. Ges.* 1869, 441.

* H. Chandler, *CHEMICAL NEWS*, 1871, No. 586, p. 77.

† L. Leislert, *Dingl. Pol. Journ.*, clxix., 386. *Wagner Jahresbericht*, 1866, 170.

‡ F. Michel, *Wagner Jahresbericht*, 1867, 194.

NICKEL AND SILVER ALLOY.

By Major W. A. ROSS.

MESSRS. JOHNSON and MATTHEY, of Hatton Garden, gave me for analysis by the blowpipe some fragments of the result of a fusion together of the metals *silver* and *nickel*, in which the silver (n) was on one side, apparently perfectly white and pure, and nickel at the other, of a dark grey colour (b).

1. A minute speck of (n), treated at the bottom of a phosphoric acid bead in P.P.,* afforded a nearly colourless transparent bead, which, treated with a momentary H.P.,* became covered with the semi-metallic coating on the surface, which shows 5 per cent of the bead to be silver solution.

2. (b), in a similar fragment and bead, gave the same reaction, but was also nut-brown hot, and orange cold, showing a large proportion of nickel.

It seems, therefore, that nickel in fusion will take up silver to a considerable extent, but that silver refuses to combine similarly with nickel.

October 4, 1876.

ON THE

PHYSICAL PROPERTIES OF GALLIUM.

By M. LECOQ DE BOISBAUDRAN.

I HAVE recently prepared rather more than half a grm. of pure gallium. In the liquid state this metal is of a beautiful silver-white, but on crystallising it takes a very decided bluish tint, and its lustre notably diminishes. On properly effecting the solidification of superfused gallium isolated crystals are obtained: these are based on a tetrahedra, which I am engaged in measuring.

On a first trial (April, 1876) the point of fusion was found between 29° and 30°, or near +29.5°. I have just examined six samples of gallium successively electrolysed from one and the same solution. The foreign metals, supposed to be present, ought to distribute themselves unequally among the different fractions collected:—

Gallium, No. 1.		Points of Fusion.
"	1.	+30.14°
"	2.	30.16
"	3.	30.14
"	4.	30.15
"	5.	30.16
"	6.	30.16
Mean		+30.15°

The sample No. 4 was afterwards placed for two hours in boiling water, and the innumerable globules formed were united by compression. The point of fusion had not varied. The metal was therefore very free from potassium. The six samples of gallium having been mixed, a fragment was taken (weighing 2½ centigrammes), which was kept for half an hour in nitric acid diluted with its own volume of water at a temperature of 60° to 70°. The loss only reached a fraction of a milligramme. The point of fusion remained fixed, for the metal melted *very slowly* at +30.16°, and crystallised *very slowly* at +30.06°. I shall shortly have the honour of submitting to the Academy the new process which served for preparing this gallium, of which the constant point of fusion denotes a very satisfactory purity.

In May, 1876, I tried to determine the density of gallium on a sample of 6 centigrammes: I obtained 4.7 at 15° (and with reference to water at 15°). The mean of the densities of aluminium and indium being 4.8 to 5.1, the provisional specific weight found for gallium appeared to agree tolerably well with a theory placing this metal between indium and aluminium. However, the calculations

established by M. Mendeleef for a hypothetic body, which seems to correspond to gallium (at least according to many of its properties), would lead to the number 5.9.

Gallium crystallised under water decrepitates sometimes when heated. Perhaps my first metal contained interstices filled with air or water. I am ignorant if this cause of error is combined with others so as to falsify my first determination. However this may be, I avoided it subsequently by heating the metal strongly and solidifying in a dry atmosphere. I then obtained higher densities, varying from 5.5 to 6.2, although the weight of the trial samples did not exceed a few centigrammes.

I finally operated with 58 centigrammes of gallium derived from the union of six samples mentioned above. Density at +23° (and referred to water at +23°)—

First experiment	5.900
Second experiment	5.970

Mean 5.935

The same gallium was afterwards maintained for half an hour between 60° and 70° in nitric acid diluted with its own volume of water, washed, very strongly heated, and finally solidified in dry air.

Density at +24.45° (and with respect to water at +24.45°) = 5.956. There is no occasion to insist, I think, on the extreme importance which attaches to the confirmation of the theoretic views of M. Mendeleef concerning the density of the new element.—*Comptes Rendus*.

NOTICES OF BOOKS.

The Mineralogical Magazine and Journal of the Mineralogical Society of Great Britain and Ireland. No 1, August, 1876. Truro: Lake and Lake.

We have great pleasure in welcoming the appearance of a magazine specially devoted to mineralogy—a science hitherto not adequately represented in our periodical literature.

The present issue contains the Rules of the Society as adopted at its first meeting, on February 3rd, 1876, and an account of the papers read at the Ordinary Meeting held on February 4th, and at the Local Meeting of the Cornish members at Redruth, July 1st.

These pages comprise a note, by Mr. Marshall Hall, upon a portion of basalt from the Mid-Atlantic, fished up by the steamer *Faraday* whilst grappling for a broken telegraph-cable. The question arises whether the fragment has been wrenched off some submarine ridge, or whether it is an ice-borne mass deposited by an iceberg.

Mr. W. W. Stoddart contributes a paper on the "Occurrence of Celestine in the Keuper Marls, and its Influence on the Composition of Plants." The author has discovered strontia in the ash of eight plants, including the common dandelion and groundsel, found growing on the Keuper marls, on the north-eastern side of Cotham Hill, near Bristol.

Mr. C. Le Neve Foster read a paper on "New Minerals and Mineral Localities in Cornwall and Devon." The species described are—Henwoodite; Pyrophyllite, found for the first time in England at Brookwood Mine; Enysite, from St. Agnes; Actinolite, with green garnets; and Aximite, from St. Terras and South Brent.

Mr. Collins also described Henwoodite and Enysite, and gave a notice of the occurrence of Scorodite, Pharmacosiderite, and Olivenite, in the greenstone at Terras Mine, St. Stephens.

Mr. Vivian communicates a note on "Paragenetic Formations of Carbonate of Lime and Oxide of Iron, and of Quartz and Oxide of Iron, at the Mwyndy Iron-Mines, Glamorgan." Mr. J. H. Collins also furnishes an additional note on the species described by Mr. Vivian.

Mr. C. Le Neve Foster describes and figures a new form

* See "Pyrology," pages 36 to 38.

of blowpipe lamp suitable for travellers, and Mr. Dudgeon gives "Historical Notes on the Occurrence of Gold in the South of Scotland."

We believe there is ample scope both for the Mineralogical Society and for its Journal, and we wish them a successful career.

Stanley's Metro-Diagram, Illustrating the Metric System with Explanations, Tables of Length, Surface Capacity and Weight, Rules, Approximate Equivalents, &c. A. and T. W. Stanley, New Britain, Connecticut.

THIS is a useful pocket companion intended to facilitate an understanding of, and prepare for the introduction of, the metric system of weights and measures. On a folding slip of "artificial parchment," which, by the way, appears to be an excellent material for plans, maps, and the like, requiring to be folded up, is engraved at full size the standard yard of England and America divided into inches and tenths of an inch. Parallel with it is a meter, graduated into decimetres, centimetres, and millimetres, so that the conversion of any lineal measure from the one standard into the other can be effected at a glance. Another diagram, all on the same slip, shows one decimetre with its subdivisions placed side by side with the approximately equal measure of four inches. The remainder of the space is utilised for a brief exposition of the advantages of the metric system, an account of its units, with tables of approximate equivalents, and rules for conversion. The back of the slip is occupied with views of the Philadelphia Exhibition building, with the dimensions stated on both systems.

We heartily wish that some unanimous decision concerning weights and measures could be reached by the civilised world. As regards the metric system England and America seem each to be waiting for the other. A commission of engineers, &c., entrusted by the Franklin Institute with the task of examining into the question, reported against the new weights and measures. One of their arguments was, that as something like three-fourths of the entire foreign trade of America was carried on with Great Britain and its dependencies, the introduction of the metric system would rather hinder than facilitate business.

CORRESPONDENCE.

PROF. DITTMAR AND THE "ANALYST."

To the Editor of the Chemical News.

SIR,—The subject of the recent attack on Prof. Dittmar was brought before the notice of the Glasgow Meeting of the Public Analysts, and the attack was condemned by those present at the meeting. So decided was the expression of condemnation that a vote of censure on the Committee of Publication was even mentioned; but in place of so extreme a course (which in my opinion ought to have been followed) an *indirect* vote of censure was carried, the resolution being to the effect that before commentaries on adulteration-cases are inserted in the *Analyst* the chemists implicated should be communicated with.

I observe that the current number of the *Analyst* purports to give an account of the Glasgow Meeting of the Society, but does not in any way record the resolution passed at that meeting. I observe also an editorial commentary on Mr. Dittmar which is in direct opposition to the resolution passed by the meeting; and I take this opportunity of making known that the Society of Public Analysts has no real control over the *Analyst*, which is the property of Mr. Wigner and Dr. Muter, who alone are responsible for the contents of the paper.—I am, &c.,

J. ALFRED WANKLYN.

Laboratory, 117, Charlotte Street, Fitzroy Square,
October 2, 1876.

DR. LUNGE'S APPARATUS FOR MAKING CHLORATE OF POTASH.

To the Editor of the Chemical News.

SIR,—In the translation of Dr. Mylius's "Report on Chlorine, &c." (*CHEM. NEWS*, vol. xxxiv., p. 139) there is a quotation from a paper of mine, published nearly ten years ago, which might mislead your readers as well as those of the original German Report. Dr. Mylius quotes my description of a small apparatus for making chlorate of potash as if I had stated that form of apparatus to be in general use in England, whilst the contrary will at once be apparent to any reader of my original paper in *Dingler's Polytechnisches Journal*. The apparatus in question would only suffice (as stated by me) for making 7 cwts. of potassium chlorate per week.

Dr. Mylius also quotes a proposal of mine for obtaining powdered potassium chlorate by disturbed crystallisation. I do not now think that that proposal is worth very much, for, in the first instance, the powder thus obtained would not be anything like fine enough for the users of that article, and would thus have to be passed through a mill anyhow; secondly, manufacturers of that article have always a considerable quantity of siftings from the coarser crystals on hand, which can only be advantageously worked up by grinding them to powder. The danger of grinding potassium chlorate—which I apprehended at that time to be very considerable—I have not, after some years' practical experience, found to be very great, provided the material is kept clear from splinters of wood or bits of iron, and the mill is not allowed to get hot.—I am, &c.,

GEORGE LUNGE.

Zürich, October 4, 1876.

CALCULUS IN HORSES.

To the Editor of the Chemical News.

SIR,—I have been investigating the nature of the concretions found in the large intestine of horses, and I trust to be able in a short time to communicate to your journal the full details and analyses of these calculi.

In the meantime allow me to observe that we lose a considerable number of valuable horses every year by this terrible disease, particularly those devoted to labour in the iron districts, which animals are generally very fine and powerful, and highly fed. One of my relatives has lost in this way no less than five splendid horses within a short space of time, and millers' horses are very liable to the disease both here and on the Continent.

The calculi are formed in the large intestine (cæcum); they begin often by being triangular, or sometimes perfectly square, with rounded edges and corners, and become finally circular. In all cases they are formed of highly crystalline concentric layers, and attain to 18 or 20 inches in diameter, that is, as large as an ordinary gas-lamp globe. I believe that this is the greatest size they can arrive at, and that when so large as this, they already press out the sides of the intestine, producing inflammation and violent pain, which causes the animal to roll about in agony, and sooner or later kills him. I have met recently with two calculi of this enormous size, both cases being Staffordshire horses.

The usual remedy, as far as I have ascertained, has been, hitherto, some powerful purgative, chiefly aloes; and when the calculi are small or recently formed—not larger than walnuts—this appears to answer. But when large such treatment only increases the evil.

I find that the greater bulk of these calculi, large or small, consists of *phosphate of ammonia and magnesia*, and when a portion of the pulverised calculus is heated over a spirit-lamp on a platinum dish, it shows that very curious phenomenon of incandescence, or rather *phosphorescence*, peculiar to this salt at a certain temperature. The amount of organic matter is not great, but I have

found what I consider, at present, to be lithofellic acid, and a few other substances, but practically of no great importance.

The points to which I wish to-day to call the particular attention of veterinary surgeons and others are these—

1. That the calculi are owed almost entirely to phosphate of ammonia and magnesia.

2. That this salt is contained in the corn; and here arises the question whether corn is not for the horse as artificial a food as meat is for the human race.

3. The ease with which these calculi can be decomposed, broken up, dispersed, or dissolved by means of weak hydrochloric acid.

I am of opinion that repeated doses of very dilute hydrochloric acid, say 2 to 5 per cent, in water or spirit, if it can be made to reach them, would destroy the largest of these calculi in a comparatively short space of time. This treatment, with appropriate diet, would, I feel convinced, prove effectual even in very bad cases.

The disease no doubt originates from the cæcum becoming alkaline instead of remaining slightly acid as it should be in a normal state of health; the calculus itself is alkaline, and contains minute quantities of carbonate of ammonia and tribasic phosphate of magnesia, as well as the phosphate of ammonia and magnesia which constitutes the greater part of it. It is a very rapid disease; when once started a few years will find it increased very considerably. To cite one instance that has come under my own observation, a fine cart-horse was born in Hereford, where it remained four years, and then went to Staffordshire, where it lived five years longer. It died of calculus at nine years of age, and the calculus was 20 inches in circumference—the size of an ordinary gas-lamp globe—and weighed 8 lbs., so that it must have increased at least about 1 lb. a year, perhaps much more.

The lime in the water drunk by horses, to which some have attributed the disease, has nothing to do with it. It originates in the food—in the corn—as I have stated above, and is due no doubt, in great measure, to a want of salt in the food. When horses are highly fed for labour in the industrial districts, it is essential that they should have access to lumps of salt to lick, or have salt in their food and a liberal supply of water to drink. The ventilation and drainage of the stable is another important consideration. How many valuable beasts after a hard day's work pass the night in an atmosphere loaded with fumes of ammonia!—I am, &c.,

T. L. PHIPSON, Ph.D., F.C.S., &c.

Laboratory of Analytical Chemistry,
Putney, London, S.W.,
September 24, 1876.

DETERMINATION OF GOLD IN PYRITES.

To the Editor of the Chemical News.

SIR,—Why do M. H. Schwarz and the gentleman signing himself "Latent" in the CHEMICAL NEWS, vol. xxxiv., p. 132, propose to fuse the pyrites with iron turnings at all? There is nothing whatever to be gained by so doing, and they would get the gold into a quantity of regulus very much larger than necessary and very inconvenient for further treatment. If they simply fuse the pyrites alone at a strong heat, with such flux as the gangue, if any is present, may require, a very much smaller regulus will result, equally sure to contain all the gold, and equally suitable for treatment with acid.

The simplest mode of treating the insoluble residue after acting upon the regulus with acid, would be to collect it on a small filter, dry it, lay it upon a scorifier, cover with assay-lead, fuse, and scorify in a muffle, finally cupelling the lead-button. This method of assay might be advisable in cases where very small amounts of gold are to be determined; but in most cases it could not compare, for convenience, with the direct treatment of the ore

by scorification or by reduction of litharge, concentration of two or three lead-buttons so obtained, and cupellation.—I am, &c.,

ASSAYER.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 10, September 4, 1876.

Researches on the Disappearance of the Ammonia Contained in Waters.—M. A. Houzeau.—Spring- and river water contains little ammonia, whilst rain, dew, and fog often contains it in abundance. Well-waters rapidly lose their ammonia, even when contained in vessels hermetically sealed. This loss is promoted by light.

Results Obtained on the Extraction of the Juice of the Sugar-Cane by means of New Apparatus.—MM. Mignon and Rouart.—The cane is cut up by means of a machine like that contrived by MM. Labrousse for reducing straw to a pulp for the paper manufacture. The pulp thus obtained is subjected to hydraulic pressure at 80 atmospheres. The canes thus yield 77 per cent of rich juice.

Detection of Magenta used in the Sophistication of Wines.—M. V. Didelot.—The author has forwarded to the Academy a sample of gun-cotton dyed with a wine containing magenta.

Dissociation of Bicarbonate of Soda at 100°.—M. V. Urbain.—The author maintains, in opposition to M. Gautier, that if dried plasma is submitted to a temperature of 100° the bicarbonate of soda which it contains is not decomposed.

No. 11, September 11, 1876.

Process for the Detection of Wines Artificially Coloured.—M. L. Lamattina.—To detect wines artificially coloured, the simplest method is to mix 100 grms. of the wine with 15 grms. of wine in coarse powder, stir the mixture for twelve to fifteen minutes, and filter through a double filter. If the wine is pure it passes through colourless, but if it preserves its colour it has been artificially coloured. If pure peroxide of manganese has been employed this process is applicable to all the colouring matters artificially introduced, including magenta. If the peroxide of manganese is ferruginous, the acids and salts of the wine dissolve the iron; magenta, if present, forms an insoluble compound, which remains on the filter. The filtrate then takes a faintly yellowish colour, resembling that of sesqui-salts of iron. In this case the peroxide of manganese left upon the filter is treated with alcohol, which dissolves the magenta, whilst the natural colouring matter of the wine is insoluble. If the alcoholic filtrate remains of a blue slightly yellowish the presence of magenta may be suspected. If we add to this liquid concentrated acetic acid, and then a few drops of ammonia, the colour of the magenta reappears after stirring for a few moments.

Note on the Radiometer.—W. Crookes.—(Extract from a letter to The Count Th. du Moncel.)

Justus Liebig's Annalen der Chemie,
Band 182, Heft 1 and 2.

Contributions to the Theory of Luminous Flames.—Dr. Karl Heumann.—(Second section; see band 181, page 129.) The author considers the circumstances that a gas-flame does not actually touch the edge of the burner,

nor a candle-flame the summit of the wick; and that a flame never comes in close contact with a cold body is due to the fact that heat is conducted away by the solid body. The flame-gases are cooled for a certain distance below their ignition-point, and the flame is consequently extinguished within this region. The distance between a gas-flame and the burner is considerably increased if the inflammable gas or vapour streams out under a high pressure, or is mixed with a large amount of some non-inflammable gas. This phenomenon is due not merely to the cooling action of the gaseous stream and of the external air, but to the fact that the speed of the issuing gas stream close to the burner is greater than the speed of the propagation of ignition. When other influences are not essential, the flame begins in that section of the issuing gas-current where its speed equals the speed of the propagation of ignition. Hence this speed of propagation for different gases and vapours may be experimentally ascertained. In case of solids and liquids of a combustible nature the same speed may also be readily found by experiment, and the results may be regarded as relative numerical expressions of the dangerous character of the combustibles in question.

Communications from the Laboratory of the Polytechnic School of Delft.—These communications consist of a paper on " α -Xylenolol prepared from Metaxylol, by S. Lako, and a long and important dissertation by A. C. Oudemans on the "Specific Rotatory Power of the more important Cinchona Alkaloids."

Composition of the Dialurates.—M. Menschutkin.—An account of the dialurates of ammonium, potassium, sodium, and barium.

On Tartronaminic Acid.—M. Menschutkin.—A product obtained on the decomposition of dialurate of sodium by means of water. Its composition is $C_3H_3NO_4$.

On Ethyl- and Methyl-Succinimid.—M. Menschutkin.—A brief account of the preparation, composition, and properties of these two bodies.

Substitution in Benzol.—F. Beilstein and A. Kurbatow.—Not suitable for abstraction.

Solid Compounds of Carbon in Meteorites.—J. Lawrence Smith.—To regard the carbonaceous matter of black meteorites as a kind of humus is contrary to all that we know of humus. The meteoric body is almost insoluble in alkaline lyes, gives off water only at a very high temperature after being previously dried at 110° , and burns readily upon platinum foil almost without odour, leaving much ash. According to the author's experiments it is neither humus nor true coal, but is probably an analogue of the so-called hydrate of carbon.

Examination of the Rotatory Power of the more important Cinchonic Alkaloids.—O. Hesse.—A valuable paper, but quite incapable of useful abstraction.

Behaviour of Phenol with the Cinchonic Alkaloids.—O. Hesse.—Cinchonidin and quinine combine readily with phenol, but the dextro-gyratory crystalline alkaloids, conchinin, cinchonin, and chinamin, are, in their free state, not capable of forming a phenol compound.

Remarks on Cynanchol.—O. Hesse.—The properties of this body as described by Butleroff agree with those of a mixture of echicerin and echitin.

Pyrophosphate of Lithia, Lithia-Soda, and Lithia-Potassa.—M. Nahnsen and E. Cuno.—Not suited for abstraction.

Derivatives of Glycerin.—K. Kraut.—Among the derivatives described are iodtriethylglycinammoniummethylester glycin, chlortriethylglycinammoniumplatin chloride, and diethylglycinethylester.

Communications from the University Laboratory of Graz.—These consist of a paper on trichloro-butyric acid, by K. Garzaroli-Thurnlak; another by the same author on certain salts of glyceric acid; and one on the

action of hydrochloric acid upon potassium chlorate by G. Schacherl.

On Phosphorus Pentafluoride.—T. E. Thorpe.—This compound, PF_5 , is a colourless gas of a very pungent odour, and strongly attacks the throat and the mucous membranes. It fumes in the air, and is decomposed by water into phosphoric and hydrofluoric acids. It is four and a half times heavier than air, and can be poured from one vessel to another like carbonic acid. It is neither combustible nor a supporter of combustion. It is not modified by the passage of electric sparks, nor by the introduction of oxygen or hydrogen.

Oxidation-Product of Glycogen with Bromine, Silver-Oxide, and Water.—R. H. Chittenden.—The product is an acid, for which the author proposes the name glycogenic. He describes a number of its salts.

Amidous Derivatives of Hydroxylamin.—This embraces a notice of the metallic derivatives of hydroxylurea, and the double salts of other hydroxamic acids, by N. D. C. Hodges; and one on the ester of hydroxamic acids, ethyl-hydroxylamin, and methyl-hydroxylamin, by W. Lossen and Dr. J. Zanni.

Chemical Investigation of a Case of Cystinury.—Dr. W. F. Læbisch.—In this case the occurrence of cystin was accompanied by the usual marked decrease of urea and uric acid.

Reimann's Farber Zeitung.

No. 36, 1876.

Dr. Reimann, in a paper read before the Berlin Dyers' Association, described "Pittakall," the method of preparing which has been recently re-discovered by Grätzel, of Hanover. Pittakall is insoluble in water, but dissolves in alcohol and in acids with an orange colour, and in alkalis with a magnificent violet. It dyes wool and silk direct, but cotton only when previously mordanted. This colouring-matter is of an acid character, and yields—with salts of lead, barium, aluminium, and tin—violet precipitates. Patterns of silk, wool, cotton, and mixed goods, dyed with the new colour, were exhibited. These shades resist air and light perfectly and soap moderately.

A correspondent points out that red wines cannot be coloured with magenta, because the tannin present would precipitate it as a tannate.

Les Mondes, Revue Hebdomadaire des Sciences,

No. 1, September 7, 1876.

Three Years of Experience in the Evaporation of Mother-Liquors; Treatise on the Production of Salt, showing the Advantages of Combined Evaporation from the Bottom and the Surface.—Otto Pohl.—The author, a Liverpool salt merchant, describes in this paper a series of very carefully conducted experiments on the preparation of salt, and appears to have effected very decided improvements.

No. 2, September 14, 1876.

At the recent meeting of the French Association for the Advancement of Science, held at Clermont-Ferrand, the inaugural discourse was delivered by M. Dumas. The following passage is significant:—"Except the soul, its origin, and its destiny, which pertain to the sphere of faith, the rest of the universe belongs to science. Let us leave the soul to God, morals to religion and to philosophy (metaphysics), and human passions to the poets, and let us march on resolutely to the scientific conquest of the universe; the field is vast enough for our free discussions."

Hoffmann's "Fringe" Polarimeter.—The construction of this instrument cannot be made intelligible without the accompanying illustration.

A meteorological observatory has been established on the summit of the Puy de-Dôme.

No. 3, September 21, 1876.

Fuming Sulphuric Acid.—M. Winckler proposes to manufacture this acid by passing a proper mixture of sulphurous acid and oxygen over platinised asbestos.

Gazzetta Chimica Italiana.
Anno vi., 1876, Fasc. v. and vi.

Use of Hydrosulphite of Soda as a Reagent in the Analysis of Colours fixed upon Tissues.—G. Scurati-Manzoni.—The facility with which orchil is discoloured by the action of hydrosulphite suggested the idea of using it for estimating the value of orchil-paste and extract, but the attempt proved unsuccessful.

Methods of Preparing the Iodides of Potassium and Sodium and the Bromide of Potassium.—P. Chiappe and O. Malesci.—To a solution of potassa at 30° B. the authors add iodine in fine powder till the mass remains coloured slightly red by iodine in excess. It is then mixed with iron filings, and heated in the sand-bath.

Observation on a Process for obtaining Iodic Acid by causing Chlorine to Act upon Iodine Suspended in Water.—G. Sodini.—In order that all the iodine should be converted into iodic acid, 1 part should be used in 20 parts of water.

Magistry of Sulphur.—M. Sansoni and G. Capellini.—The authors think it unnecessary to use pure hydrochloric acid, and employ the commercial quality, but free from arsenic.

Method of Detecting the Adulteration of Iodide of Lead.—L. Alessandri and C. Conti.—The usual adulterations are the chromate and carbonate of lead and the sulphate of baryta. Among the available tests they give the preference to potassa and ammonia, with which the detection of chrome is easy.

A New Reagent for the Detection and Determination of Glucose.—A. Soldiani.—416 grms. of bicarbonate of potassa; 15 grms. of basic carbonate of copper, dry; 1400 grms. of distilled water are placed to heat on the sand-bath in a porcelain capsule for about six hours, the liquid being kept always at the same level by adding water to make up for what is lost by evaporation, and stirring. The heat is withdrawn when the evolution of carbonic acid ceases; it is left to settle, and filtered, and concentrated to 800 c.c.

Preparation of Ferric and Cupric Oxides from their respective Sulphates without the Production of Basic Sulphates.—A. Ogialoro.—The author recommends to pour the sulphate of iron into a solution of an alkaline carbonate.

Moniteur Scientifique, du Dr. Quesneville,
September, 1876.

Relations of Chemistry with Physiology and Pathology considered especially with regard to the Brain.—C. T. Kingzett.

Chemistry of Diabetes Mellitus.—C. T. Kingzett. These two papers are translated from the English.

Pepper and its Principal Adulterations.—E. Ladrin.—Amongst the ordinary sophistications of pepper, the author enumerates pepper-dust, the epidermic portion detached from the pepper; mineral matters, such as plaster, chalk, clay, ochre, &c.; grains of paradise; dregs from the manufacture of potato-starch; farina of leguminaceous seeds; olive kernels freed from oil and ground (these are regularly sold to the trade in France as "olive crusts—grignons—for pepper"); laurel leaves and oilcakes.

Assay of Commercial Oils.—A. Pinchon.—The author recommends, for ascertaining the purity of commercial samples of oils, a hydrometer inclosing a thermometer. A precisely similar instrument has been in use in Germany and in England for about twenty-five years, under the name of Fischer's oleometer.

Anti-fermentescible Action of Salicylic Acid.—M. Neubauer.—An examination of the power of salicylic acid to arrest fermentation.

Chemical Indications relating to the Applications of Salicylic Acid.—H. Kolbe.

Use of Salicylic Acid to prevent the Fermentation of Syrups.—H. Lajoux.

The nature of these two papers is sufficiently evident from their title.

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Organic and Mineral Phosphates in Manure.—Will any of your readers inform me of a method of distinguishing accurately between organic and mineral phosphates in a mixed manure.—E. C. POTLER.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 881.

DYSODILE.

By Prof. A. H. CHURCH.

THE paper-coal from Melili, Sicily, has been long known. Similar minerals have been described from several lignite deposits in different parts of Europe. I have often desired to ascertain whether there might be any near relationship between this paper-coal (sometimes termed *dysodile*) and the *tasmanite*,* which I analysed and described in 1864 (*Phil. Mag.*, IV., xxviii., 465). Both minerals burn with a most offensive odour, fully accounted for in the case of *tasmanite* by the presence of much unoxidised sulphur in union with the carbon, hydrogen, and oxygen of the mineral. Analysis shows, however, that the resemblance of the two species is very slight, as the following results will demonstrate.

A characteristic specimen of *dysodile* from Rotl, near Bonn, was submitted to examination. To remove matters soluble in water, and notably gypsum, it was powdered, and then washed with much water. Subsequently it was treated with moderately strong hydrochloric acid, until neither iron nor sulphuric acid could be detected in the acid liquid or washings. Thus it was expected that the high percentage of mineral matter in the original sample would be lowered, while all sulphates would at the same time be removed. The latter change was probably accomplished, not so the former. The following figures comprise the chief analytical data from which the ultimate composition of *dysodile* may be deduced:—

A. *Dysodile* thoroughly washed with Water and Hydrochloric Acid, and dried at 100° C.

0.328 grm.	gave 0.1640 grm.	ash,	or 50.00 p.c. ash.
0.328 "	" 0.0980 "	Fe ₂ O ₃ ,	or 28.88 " ZnO ₃ .
0.651 "	" 0.0555 "	BaSO ₄ ,	or 1.17 " S.
0.593 "	" 0.7515 "	CO ₂ ,	or 34.56 " C.
0.593 "	" 0.2685 "	H ₂ O,	or 5.03 " H.

B. *Dysodile* treated with Water and stronger Hydrochloric Acid.

0.0885 grm.	gave 0.0298 grm.	ash,	or 33.67 p.c. ash.
0.3415 "	" 0.0615 "	PtAm ₂ Cl ₆ or	1.13 " N.

It appears from the above figures that the composition of the carbonaceous or combustible part of *dysodile* may be represented by the following percentages, if the ash present be previously deducted:—

Composition of *Dysodile*.

	In 100 parts.
Carbon	69.01
Hydrogen	10.04
Sulphur	2.35
Nitrogen	1.70
Oxygen	16.90

It is thus evident that *dysodile* does not belong to the same group of minerals as *tasmanite*, for the latter species is 10 per cent richer in carbon than the former. *Dysodile*, indeed, is possibly, perhaps even probably, a mixture of two or more distinct substances. Nor can the percentages given above be regarded as necessarily representing the carbonaceous constituent of the mineral. The sulphur, for example, may really belong to some fixed sulphide, such as pyrites, in the ash. Not till *dysodile* can be secured tolerably free from ferruginous ash can the mode

of combination in which the sulphur occurs be determined. As *tasmanite* can be obtained (by the use of mechanical means, aided by the action of hydrochloric and hydrofluoric acids) contaminated with no more than 1½ per cent of a white or grey ash, we can prove that the high percentage of sulphur in that species exists in organic union with carbon, hydrogen, and oxygen, and not in the form of iron pyrites.

NOTE ON THE EFFECT OF TEMPERATURE ON THE GROWTH OF POTATOES.

By J. B. HANNAY, F.R.S.E.

IN a former paper published in this journal* I gave my reasons for rejecting the theory that the proportions of the inorganic constituents have much to do with the health of the plant; in short, that we could not by an analysis of potato ash declare whether the tuber had been sound or not. I there showed that sound or diseased potatoes from the same field had virtually the same proportions of inorganic compounds, while potatoes from the same seed grown on different soil may have very different proportions of these compounds. These results have since been corroborated by other investigators, but I would wish to place on record further evidence I have obtained by analysis of the ash of potatoes grown near the sea-shore as compared with that of tubers from the same seed grown at some distance from it; both soils were gravelly. In the subjoined analyses No. I. is that from the shore, and No. II. that from inland. They both received the same manure. The method of analysis was that used by Bunsen.

	No. I.	No. II.
Percentage of ash from dried tuber	4.25	4.08
Soluble portion—		
Potassium	32.55	38.81
Sodium	10.87	3.96
Magnesium	2.22	1.04
Carbon dioxide	14.29	14.97
Phosphoric oxide	4.01	5.83
Sulphuric oxide	2.74	5.22
Chlorine	10.59	6.58
Insoluble portion—		
Silica	1.85	1.94
Ferric oxide and alumina	0.25	0.80
Calcium	3.09	4.17
Magnesium	1.15	0.73
Carbon dioxide	1.31	1.88
Phosphoric oxide	3.40	4.17
Unburnt carbon	0.50	0.62
Oxygen equivalent to metals minus equivalent proportion of chlorine ..	11.63	10.68
	100.45	101.40

Both these samples of potatoes were pretty good, the last portions of the carbon were very difficult to burn away, and the starch granules were large, and on being boiled the skin of the potato burst owing to the swelling of the starch granules which the tuber contained, and yet we see that as in the case of some other plants a large proportion of one element may be replaced by another without injuring the root. It will be noticed that in diseased or weakly tubers the potassium and sodium are nearly always present in greater quantity than in those of a healthy nature. I do not think that that is so much owing to an actual excess of these elements in the diseased tubers as to the fact before mentioned that it is

* See Dana's "Mineralogy," 5th edition, pp. 746 and 747.

* "On the Inorganic Constituents of Sound and Diseased Potatoes," CHEMICAL NEWS, vol. xxvii., p. 147.

more difficult to completely oxidise the carbon in healthy tubers than in the diseased ones, and that a portion of these volatile substances is lost during the protracted ignition. This fact that the inorganic constituents are less intimately combined with the carbon compounds in diseased tubers than in those which are healthy led me to the conjecture that a kind of constitutional decay was the precursor of the real disease. The paper above referred to concluded as follows:—"On the whole I think the potato disease is a problem for the naturalist or the physiologist rather than the chemist." Now the researches of Mr. Worthington Smith have proved that the conjecture was correct, but the fact still remains unexplained that even during the worst periods of disease some fields escape infection. And I found on careful inquiry that as a general rule those fields which escaped were of a darker colour than those attacked, and this led me to the conjecture that the heat caused by the absorption of the solar rays must strengthen the constitution of the plant. Besides, as I pointed out in my former paper, soot is considered by practical men as a preventive of the disease, and it occurred to me to determine by experiment whether, besides the good which its contained ammoniacal salts does, a part of its virtue may not lie in its imparting a dark colour to the soil and so rendering it a better absorbent of solar heat. I therefore had the following experiment tried to decide this question:—

A piece of ground was chosen, little adapted for the growth of potatoes, consisting of a kind of blue till. The ground was divided into two parts, and both were planted with potatoes in the ordinary way, using stable manure. The one half was left as planted, while the other was covered with soot which had been carefully washed till no soluble matter remained in it. Those with the soot sprouted first and were all through much healthier than the others. A series of temperatures were taken until the foliage was too thick for much sunlight to penetrate, and then resumed when the foliage was beginning to fail till the tubers were dug up. The temperature of the air was not kept, as we have no idea from it what is the real temperature of the leaf, as we do not know how much heat it absorbs from the sun's rays. All the temperatures were taken on sunny days as on otherwise there was no difference in temperature. The following table gives the two series of temperatures. They were taken at 2 and 8 inches below the surface and always simultaneously, but not at regular intervals, and in reality do not represent the actual average temperature of the earth, but they serve the purpose I intended to show—the higher temperature of the dark coloured earth.

Earth Covered with Soot.		Pure Earth.	
Depth 2 ins.	Depth 8 ins.	Depth 2 ins.	Depth 8 ins.
55.4	52.6	53.0	52.1
56.9	55.0	55.2	55.4
67.2	63.9	65.1	60.8
64.5	63.2	63.8	62.4
61.7	58.7	58.8	58.0
63.0	60.6	61.4	59.2
58.1	56.9	57.2	56.3
64.2	62.2	63.5	61.8
65.4	63.8	63.9	62.0
63.2	61.4	60.0	60.0
Average	61.96	59.83	60.19
			58.74

These numbers show distinctly that the potatoes grown in a dark soil have a warmer climate, so to speak, than those in a light one. The tubers with no soot were weak and a great deal of disease among them, whereas those which had the covering were larger and nearly all healthy. Still, as the following numbers show, the principal inorganic constituents were present in nearly the same proportions. No. I. is from the soot-covered tubers, No. II. from the others,

	No. I.	No. II.
Percentage of ash	3.85	4.27
Potassium	38.25	39.73
Sodium	2.17	2.04
Magnesium	2.42	2.87
Calcium	4.02	3.75
Phosphoric oxide	10.94	10.51
Sulphuric oxide	5.22	6.83
Chlorine	5.08	6.15

The principal result to which I wish to draw attention, however, is the manner in which the starch granules are developed in the two sets of tubers. First as to quantity. The method of estimating the starch was as follows:—The best potatoes from both portions of the soil were cut up and dried, and a weighed portion treated with alcoholic potash to remove sugar, fat, &c., and dried and weighed; then treated with diluted hydrochloric acid to remove the starch, and again dried and weighed. The difference between the last two weighings gives the starch in the original quantity. In this way the potatoes grown under soot gave 22.5 per cent of starch and those in the plain ground 17.5 per cent, a difference of 5 per cent. Then as to the size of the starch granules:—Micrometrical measurements of 20 average granules in the good potatoes gave an average of 0.175 m.m., whereas 20 of those from the diseased tubers gave only 0.155 m.m. We see from this that not only were the granules smaller but their number was less. In the potatoes poor in starch the substance was altogether of a more fibrous nature. It thus appears that the increase in temperature gives a great impetus to the growth of starch granules both in size and number. I know that an investigation like this would require to be extended over several years to make sure of a definite law, and such was my intention, but as I had to leave this country last spring the experiments I intended to carry on this year were not accomplished, and I have no prospect of being able to resume the investigation soon; so I considered in these circumstances that the above results were sufficiently striking to warrant publication.

BLOWPIPE ANALYSIS OF THE NEW MINERAL HENWOODITE.

By MAJOR ROSS, late R.A.

THE first number of the *Mineralogical Society's Journal* contains the blowpipe analysis by Berzelian methods of this interesting mineral, written by Dr. C. Le Neve Foster, H. M. Inspector of Mines, who seems also to have discovered it; and Mr. J. H. Collins, the Society's Secretary, having been so kind as to forward me by letter a few pin's-head fragments of the mineral for the purpose of testing them by my methods, I have the pleasure now to send you an account of these, but, in the first place, append Dr. Foster's analysis.

"Colour.—Turquoise blue.

"Streak.—White, with bluish green tinge.

"Matrass.—Turns brown, gives H₂O, slight decrepitation.

"Pt forceps.—Colours flame green, does not fuse.

"C alone.—Does not fuse.

"Borax.—O.F. green hot, blue cold.

"Borax.—R.F. on C; Cu reduced.

"Carb. soda on C; obtained metallic Cu.

"Berzelius's test for P₂O₅.—Boric acid and Fe on C obtained round globule of phosphide of iron.

"Dissolved in H₂SO₄, added ammonia, blue solution, and white flocculent precipitate (Al₂O₃).

"Filtered, added oxalate of potassium; decided turbidity (CaO).

"The mineral is therefore a hydrated phosphate of alumina and copper with a little lime."

Dr. Foster states, with reference to the discovery:—"In looking over some specimens of *chalcosiderite* [a mineral not given by Bristow, and which the writer of this article therefore supposes to be also a new species, containing copper and iron] I noticed a bluish green mineral which was different from the rest, and subsequently, on calling the attention of Capt. Hosking, of West Phoenix, to the mineral, I obtained several pieces from him." It certainly shows great sagacity on the part of Dr. Foster to have suspected the presence of phosphoric acid in this mineral, unless *chalcosiderite* also contains that acid, but it is unfortunate that he should have omitted his reasons for the surmise from his analysis. It will be observed that, for the detection of alumina and lime, the "wet way" has to be resorted to, while the iron present is not detected at all.

*Henwoodite.**

- (1.) *Appearance*.—A rounded aggregation of lenticular crystals; pale green-blue.
- (2.) *On Al plate in O.P.*—Colour changed to chocolate-brown.
 - (a.) Adhered to a magnet (apparently due to particles of *Goethite*, which were carefully removed from the crystals).
 - (b.) Green pyrochrome; might be due to copper, molybdenum, barium, phosphoric acid, &c.; no sublimate, no sulphur reaction.
- (3.) *Crushed (2) between agates, and treated some minute particles on a bead of boric acid in O.P.*—Blue-green pyrochrome† = copper.
 - (a.) Streaks of curdy matter, heating into opalescence = phosphoric acid or water; see (5).
 - (b.) White amorphous fragments; black do., with rusty matter round. White balls = calcium phosphate, one grey ball, one black ball, all opaque. The whole bead was interspersed with shining crystalline spots = insoluble SiO_2 ?
- (4.) *Added a fragment of pure lime under O.P.*—A large clear ball; pale yellow-green hot, nearly colourless cold = FeO . (A particle of cupric oxide without iron colours a similar ball brilliant chrome green, hot or cold.)
- (5.) *Clarified the opalescent bead with potassium carbonate and magnesium sulphate.‡*
 - (a.) *Added fresh boric acid under O.P.*—The clear bead became opalescent on cooling = presence of phosphoric acid.
- (6.) *Heated another piece of (1) with pure oxide of lead on a charcoal mortar on aluminum plate.*—Fused with great effervescence to a crystalline mass of plumbic phosphate, with minute balls of copper interspersed.

(This new test for cupric phosphate is best seen with *Libethenite*. The copper disengaged seems beautifully pure.)
- (7.) *Heated a fresh piece of (1) with sodium carbonate on Al plate in O.P.*—Fused to a brick-red mass = Cu_2O .
- (8.) *Crushed (7) in (a) forceps|| on agate slab, and boiled in water acidulated with boric acid.*—Two precipitates (a) brown, flocculent, above; and (b) brick-red, below = Cu_2O .
- (9.) *Treated (8 a) in a boric acid bead under O.P.*—Great opalescence = phosphoric acid (as was seen by (5 a)); some opaque white balls; ditto ditto fragments; two black balls; several clear small crystals = SiO_2 .

* I had the great advantage of seeing Mr. Collins's quantitative analysis of the mineral in the Society's journal, but having lent my copy to a pupil (Mr. Lombardi), I only remembered that *Henwoodite* is "a hydrated phosphate of alumina and copper."

† Abnormally coloured flames are called "pyrochromes" by me.

‡ See page 186, "Pyrology," "The Test for Phosphoric Acid."

|| See page 69, *Ibid*, Article, "Matériel."

(10.) Repeated (5) and again proved the presence of phosphoric acid.

Remarks.—The presence of alumina or aluminum phosphate is seen from (3 b) and (8 a); of silica from (3 b) and (9); of lime from the white balls, which might, however, have been MgO . The presence of copper was so evident that it was unnecessary to use phosphoric acid as a detective.

The minuteness of these details (necessary where a process is described for the first time) makes the analysis appear much longer than it is, but the essential character of the mineral appears in operation (3), what follows that is chiefly confirmative.

September 19, 1876.

NOTE ON THE RADIOMETER.*

By WILLIAM CROOKES, F.R.S., &c.

DURING the last three months several papers have been read before the French Academy respecting the radiometer. On reading these papers I find that the various experiments performed are in general repetitions of some which I have devised during the four years I have been working at the subject. The descriptions of my experiments and the results I have obtained have been communicated by me from time to time to the Royal Society. Unfortunately, however, these papers do not appear in the *Philosophical Transactions* until twelve or eighteen months after they have been read, and according to custom I could not communicate them to other learned Societies. If these *savants* had seen my papers they would have found that I had not only tried the experiments, but that I had also discussed the evidence both for and against the several theories they have advanced to account for the action of the radiometer. The experiments with radiometers are almost all described in the third and fourth parts of my paper: these were read before the Society on February 10th, 1876, while in parts one and two I have considered the various supposed causes of the phenomena.

In the *Comptes Rendus* for July 3rd, 1876, M. Govi describes an experiment showing the action of dark heat on the instrument. This experiment is described in the paper read before the Royal Society on February 10th, and was also shown at a *Soirée* of the Royal Society on April 5th. The radiometers described by MM. Alvergnyat and Gaiffe, in the *Comptes Rendus* of July 24, differ in nothing from those that I had previously caused to be constructed, and which are also described in the paper referred to above, while M. Ducretet's experiment of pouring ether upon the case of the radiometer was demonstrated to my audience on the occasion of my lecture at the Royal Institution, on February 11th, 1876. At the Royal Society *Soirée*, April 5th, I exhibited the turbine-radiometer, and this is also described in the paper read on February 10th. In the *Comptes Rendus* for June 19th a similar instrument is explained by M. de Fonvielle. With regard to the cause of the rotation, M. de Fonvielle adheres to the theory of emission; while M. Fizeau, in the *Comptes Rendus* of May 29th, attributes the action to, first, a slight excess of temperature acquired by the discs as compared with the ambient medium under the influence of light; secondly, to the unequal powers of emission and absorption of two opposite surfaces (black and polished of each disc; thirdly, to the presence, in the apparatus, of a small quantity of elastic fluid. In the No. for June 19th M. Govi refers to Fresnel's experiments, which he will find described in my paper read in December, 1873; and he also says that, if the thermic currents of rarefied gases contained in the receiver do not suffice for explanation of the facts observed, there is another explanation, namely,

* Translated from a Letter to Count du Moncel, published in the *Comptes Rendus*, September 11, 1876.

by the dilatation by heat or the contraction by cold, of the gaseous layers which all bodies retain on their surface, even when placed in an absolute vacuum. In the *Comptes Rendus*, June 26, M. Ledieu bases his explanation on a mechanical action of the "ether" perpendicularly to the direction of its rays of propagation, and not in the same direction as those rays. Others ascribe the action to electricity. Now, in my paper read before the Royal Society in April, 1875, I have discussed all these theories, and described the experiments consequent upon them. I have there shown that, while either of the theories will account for some of the phenomena, it is not so easy to find an explanation which will satisfy all the conditions of the problem. Referring to M. Hirn's communication in the *Comptes Rendus* of June 26, I may mention that on March 30, 1876, I read a paper at the Royal Society on the "Movement of the Glass Case of a Radiometer," in which I showed that the internal friction, either of the steel point in the glass socket, of the vanes against the residual air, or of both these causes combined, was considerable; and on the 15th of June last I stated, in a paper to the Royal Society, that the evidence afforded by my latest experiments is to my mind so strong as almost to amount to conviction that the repulsion resulting from radiation is due to an action of thermometric heat exchanged between the surface of the moving body and the case of the instrument through the intervention of the residual gas. This explanation of its action is in accordance with recent speculations as to the ultimate constitution of matter and the dynamical theory of gases.

MEMOIR ON THE ACTION OF ALCOHOL ON THE BRAIN.*

By CHARLES T. KINGZETT, F.C.S.,
London and Berlin.

THE question of the action of alcohol on the nervous system has long occupied the attention of physiologists, but the researches that have been conducted at various times by various workers have not led to any very decided results. They have, moreover, been directed to a study of the *channels* through which the alcohol may be supposed to act, rather than to the action itself. This, indeed, was almost unavoidable, for although there were many theories regarding the *modus operandi* of alcohol in the system, and especially in regard to the nervous system, our knowledge of the nervous system itself was very imperfect, and remained so until quite recently, when, by the researches of Thudichum, the chemical constitution of the brain has been elucidated. (More recently, papers on the specific points of the same subject have been published by Thudichum and the author.) The possession of this knowledge enables us to indicate fresh lines of research from which the physiological action of alcohol may be studied.

In 1859 Dr. Marcet, F.R.S., read before the British Association a paper on this subject, in which he endorsed the views of Dr. J. Percy, who had, in 1839, published a research on the presence of alcohol in the ventricles of the brain. Dr. Percy concluded "that a kind of affinity existed between the alcohol and the cerebral matter." His investigation was of an experimental nature, and he states that he was able to procure a much larger proportion of alcohol from the brain than from a greater quantity of blood than could possibly be present within the cranium of the animal upon which he operated.

Dr. Marcet in considering these researches alludes also to the researches of L. Lallemand, Michel Perrin, and Duroy, "who withdrew the blood from the brain in cases of poisoning with alcohol, and succeeded in extracting alcohol from the cerebral substance, thus free from blood." (*loc. cit.*) Finally, he describes physiological experiments,

from which he concluded that "alcohol acts *principally*, though not *exclusively*, on the nervous centres by means of absorption, and consequently through the circulation;" and, further, that it also "exerts a *slight* but *decided* action on the nervous centres through the nerves, independently of the circulation."

The more general question of what becomes of alcohol in the system has been far more deeply studied. I do not propose to enter into it except so far as to indicate our present absolute knowledge on this point.

Thudichum was the first to determine quantitatively the amount of alcohol eliminated by the kidneys from a given quantity of alcohol administered, and the result was sufficient in itself to disprove the elimination theory, at that time prevailing very widely.

The subject, however, was followed up by Dupré and others, and the results of their continued researches may be given in Dupré's own words (See *Practitioner*, March, 1872), from the abstract of a communication to the Royal Society:—

- "(1.) The amount of alcohol eliminated per day does not increase with the continuance of the alcoholic diet; therefore, all the alcohol consumed daily must, of necessity, be disposed of daily, and as it is certainly not eliminated within that time it must be destroyed in the system.
- "(2.) The elimination of alcohol following the taking of a dose of alcohol is completed twenty-four hours after the last dose of alcohol has been taken.
- "(3.) The amount eliminated in both breath and urine is a minute fraction only of the amount of alcohol taken."

Now it must be pointed out in regard to all these researches that they have reference to quantities of alcohol, which are certainly below those quantities which by consumption give rise to "delirium tremens." In this disease the amount of alcohol eliminated is much greater, and, in any case, the fact that alcohol is *not* eliminated does not prove what becomes of it. Certainly we know that it is oxidised in the circulation, but we neither know the products of that oxidation nor the time which is necessary for its completion, and if there be any truth in the researches of Percy and others alluded to, the alcohol may be absorbed into and remain with the cerebral matter or other tissues until, by the obtaining of necessary conditions, it may be re-absorbed into the circulation and oxidised there. Meanwhile, assuming it to remain for a time with the cerebral matter, how may it be supposed to act in order to bring about the disease called "delirium tremens?"

It had been my intention to determine quantitatively the amount (if any) of alcohol which may remain in the brain-substance of animals to which large quantities of alcohol may be administered. In this matter, however, I have been disappointed, and my researches therefore go upon the assumption that Percy was right in his conclusions.

I have pointed out in a previous publication, "On the Relations of Chemistry to Physiology and Pathology with special reference to the Brain," that alcohol may be supposed to act, when present in large quantity, upon brain-matter in one of two ways, or in both. (See *CHEMICAL NEWS*, vol. xxxiii., p. 79.) The brain, with its water of colloidal, has a mobility of ultimate particles, which enables it to assimilate matters from the blood which readily diffuses through it on the one hand, and a penetrability which allows of the crystallisable products of life being carried away by the blood on the other side. Now, from what Thudichum has found regarding the chemical constitution of the brain (See "Report of the Medical Officer of the Privy Council and Local Government Board," New Series, No. III.), it may be supposed that alcohol would act on it as a whole by robbing it of its mobile character, so essential to its healthy functions, and consequently impair its power to assimilate its food and its

* Read before the British Association, Glasgow Meeting (Section D.).

power to throw off the products of its life functions: or alcohol may be supposed to act by dissolving traces of the principles of which brain-matter is composed—albumin, kephalines, myelines, and cerebrines, &c.

I now proceed to describe the experiments I have conducted to study these points before stating the conclusions which follow from them.

As it was impossible to carry on my experiments either upon live beings or upon human brains, I had recourse to ox brains, which in each case were removed from the skull after death and immediately before experimenting upon them.

Experiment I.—In this experiment an ox brain, recently removed from the skull, was maintained by means of a water-bath, at a temperature of the blood, suspended in water containing varying amounts of alcohol, or in water alone for seven hours in each case.

The amounts of water and alcohol employed in the various experiments were as under:—

Water.	Absolute Alcohol.	Alcohol equals—
A. 1000 grms. and 200 grms.		16 per cent.
B. 1000 "	100 "	9 "
C. 1000 "	200 "	16 "
D. 1000 "	100 "	9 "
E. 1000 "	50 "	5 "
F. 1000 "	0 "	—
G. 1000 "	200 "	16 "
H. 1000 "	400 "	27 "
I. 1000 "	400 "	27 "

The method of examination employed consisted in the evaporation of the various extracts to dryness in a water-bath and the analysis of the products.

The amount of matter which passed into solution gradually diminished with each extraction, while the nature of the matters dissolved appeared identical or nearly so, with the exception of the first extract. This contained more albumen, and what may be called water-extracts of the brain. These matters, to be presently described, would appear to have been present in great part diffused through the brain, not in a state of strong combination; they might, therefore, be regarded in part as food-forming matters, or as brain excrementitious fluids.

As much as was necessary of the small amounts of matter dissolved in each case was used for ascertaining the specific nature of the constituents. Those quantities remaining over were united and examined in bulk.

Among the constituents were observed myeline, and identified by the test with sulphuric acid and sugar; by its deposition from an alcoholic solution on cooling; by its CdCl_2 salt; and the presence of phosphorus both in the free body and the CdCl_2 salt.—No kephaline dissolved. A considerable amount of water extractives, containing a phosphorised principle insoluble in strong alcohol, and not before recognised.—Potassium, chlorine, and alumina.

Before the conduction of trial F. the brain was allowed to stand in water during twelve hours to wash it free from any alcohol that may have been left in it from the previous experiments. The extract in this experiment certainly contained myeline, and also the phosphorised principle insoluble in strong alcohol, besides alumina. A form of cerebrine was also found amongst the dissolved matters, no matter whether alcohol had been used or not. It was established by re-crystallisation from alcohol, inability to form a CdCl_2 salt, and its freedom from phosphorus.

It should be observed that in the later extractions, although much alcohol was employed, the amounts of matter dissolved were extremely small. This gradual decline in the amount of matter extracted may be ascribed to two causes. First, apparently there existed diffused through the brain matters in a state of solution, left there doubtless by the blood; but, secondly, the brain gradually grew harder and firmer, until finally its mobility of particles was almost entirely lost. Such a growth in the

hardness would prevent the intimate ingress of the solution into its parts.

It was chiefly to test this last statement that *Experiment II.* was conducted. This employed a fresh ox brain, which was hardened by boiling in water for ten hours (in two successive litres). After this it was extracted as described, and the weights of the extracted matter dry at 100°C ., and its analysis was in each case registered. These are tabulated.

Nature of Solution used to Extract.	Weight of Matter Dissolved.
A. 2 litres H_2O at 100°C .	4.6 grms.
<i>Nature.</i> —No kephaline; cerebrine; myeline; no phosphates; extract was precipitated by PbA ; noH_2SO_4 , much Cl ; phosphorus; albumin.	
Nature of Solution used to Extract.	Weight of Matter Dissolved.
B. 200 grms. alcohol, 1000 " water = 16 p.c. alcohol.	1.0 grm.
C. 1000 grms. water.	0.5 grm.
D. 400 grms. alcohol, 1000 " H_2O = 27 p.c. alcohol.	0.4 grm.
E. 1000 grms. water.	0.3 grm.
F. 600 grms. alcohol, 1000 " water = 35 p.c. alcohol.	0.6 grm.
G. 400 grms. alcohol, 1000 " water = 27 p.c. alcohol.	0.25 grm.
H. 400 grms. alcohol, 1000 " water = 27 p.c. alcohol.	0.40 grm.
I. 400 grms. alcohol, 1000 " water = 27 p.c. alcohol.	0.28 grm.
J. 1000 water.	Lost.
K. 1000 water.	0.19 grm.
L. 1000 water.	0.19 grm.

Nature.—All these extracted matters seemed of similar nature, and all gave the purple reaction with H_2SO_4 and sugar. For analysis see *Experiment III.*

Experiment II. seemed to indicate (see F.) that when the amount of alcohol exceeded a given quantity more matter was dissolved, and in order to confirm this, and to ascertain its nature, the following—

Experiment III. was carried out on a new ox brain. Each extraction, like as in experiments I. and II., was sustained during seven hours at a blood-heat. The results are tabulated.

ExtraGtive Solution Employed.	Weight of Matter Dissolved.
	Grms.
A. 1000 grms. water	1.40*
B. 400 grms. A., 600 W., = 37 p.c. alcohol	1.70
C. 400 " 600 " 37 " "	0.84
D. 400 " 600 " 37 " "	0.80
E. 400 " 600 " 37 " "	0.60
F. 400 " 600 " 37 " "	0.50
G. 400 " 600 " 37 " "	0.40
H. 1000 grms. water	0.40
I. 1000 " " " " " " " "	0.35
J. 1000 " " " " " " " "	0.30
K. 1000 " " " " " " " "	0.28
L. 1000 " " " " " " " "	0.28
M. 400 grms. A., 600 W., = 37 p.c. alcohol	0.25
N. 400 " 600 " 37 " "	0.23
O. 600 " 400 " 54 " "	0.85
P. 600 " 400 " 54 " "	0.90
Q. 500 " 500 " 46 " "	1.90†

* Not including albumin, which was removed by filtration from concentrated extract.

† In this experiment the brain before extraction was minced.

which follow give a lucid account of the various descriptions of food in detail, the whole terminating with some excellent practical remarks on the scientific principles of cooking. In the chapter on water the remarks on filtering and filtering media are judicious, and the common error that a filter will last for an indefinitely long period is clearly pointed out. The authors dwell at considerable length on the pernicious effects of "previous sewage contamination" on drinking water, but their remarks on this subject might very well have been supplemented by a warning to their readers of the mischief arising from subsequent sewage gas contamination which, in ninety-nine cases out of a hundred, the water receives after it has found its way into the cistern. It is surely a waste of power and money to compel the different water companies to filter the water supplied by them to the public as long as householders are allowed to poison themselves and their families by using cisterns which are in direct communication with the house drain or water-closet through the waste-pipe. The next time that Dr. Drewry meets with a peculiarly puzzling case of derangement of the digestive organs we should advise him to ask his patient to allow him to look at his cistern as well as his tongue. In the following chapter the merits of condensed milk are rightly insisted on, and the authors' remarks on this valuable article of diet will do much to destroy the small amount of prejudice which still lingers among the public with regard to its wholesomeness. Messrs. Drewry and Bartlett, in the chapter on breadstuffs, are strongly in favour of the use of whole meal bread so as to receive the entire nutritive value of the wheat grain. The general public are hardly aware that the rage for white bread leads to the sacrifice of nearly 20 per cent of the flesh-forming constituents of the wheat. The thousand and one so-called farinaceous foods are very properly attacked at the end of this chapter. The pretensions which are contained in the advertisements of manufacturers of this class of foods have long been known by the merest tyro in dietetics to be false and mischievous, but the fallacy has never been so fully exposed as in the present work. In relation to this matter Dr. Harkwicke, the Coroner for West Middlesex, goes so far as to say that most of the deaths of infants under six months old arise from the use of corn flour and other kinds of starchy food. One of the largest firms in the trade coolly assert in their advertisement that when their corn flour is mixed with milk it closely resembles beef and bread! The vegetarian craze is reprobated, but we must take exception to one remark in which the authors give it as their opinion that "the cooling and laxative properties possessed by certain descriptions of fruit are those to which the greatest value must be attached." Surely the wholesome properties of the vegetable acids must have been overlooked when this paragraph was written. An eminent physician used to say that if each of his patients were to eat a couple of oranges before breakfast every morning he would lose half his practice. As a rule, we English, especially the middle classes, eat far too little fruit.

In the chapter on stimulants the ingenious action of the different aldehydes, ethers, and alcohols, other than ethylic alcohol, which are found in all new spirits are clearly pointed out. The little work concludes with some capital hints on cookery and kitchen management. We regret to see that Messrs. Drewry and Bartlett have thought proper to introduce the names of several well-known manufacturers of food products as having furnished them with "characteristic samples" of their manufactures. In a popular book like the present such "honourable mentions" savour too much of the puffing testimonial and ought to have been omitted.

Exercises in Electrical and Magnetic Measurement, with Answers. By R. E. DAY, M.A. London: Longmans, Green, and Co., 1876.

ELECTRICAL students, more especially those who are weak in geometry and mathematics generally, usually find

great difficulty in applying any of the systems of units at present in use to a variety of electrical and magnetic measurements. Even the expert scientific calculator is often at a loss when he finds it necessary to convert the results obtained by one system into those of another. Mr. Day's little manual will, we think, be useful both to the beginner and to the practised electrician. The book contains nearly seven hundred examples of exercises relating to every kind of electrical and magnetic measurement. Telegraphic testing, the measurement of magnetic force, resistance of conductors, induction and condensers, and electro-magnetic measurement, coming in for the lion's share of attention. Copious examples relating to liquid and battery resistance, shunts, and derived circuits, heating effects of currents, &c., are also given. The problems are preceded by a short preface giving an account of the system of units of measurement adopted by the Units Committee of the British Association, and known to electricians as the c.g.s., or centimetre-gram-second system, and showing how to convert a measurement founded on one system of units into a measurement founded on another. The units employed by practical electricians such as the ohm, the farad, the volt, &c., are also defined and explained. This part of the book might perhaps have been extended with advantage. The answers to the examples are appended, but we think that for the sake of the weaker portion of electrical students a few worked-out problems might have been given. For those who are commencing laboratory practice or who are preparing for actual work in connection with electric telegraphy, Mr. Day's little book will form a necessary complement to the excellent manuals of Culley, Sabine, and Everett.

CORRESPONDENCE.

SOLID WATER.

To the Editor of the Chemical News.

SIR,—Your readers will be amused with the following correspondence which has recently appeared in the *Athenæum* anent a communication on "Solid Water" which I made to the last meeting of the British Association:—

"*ATHENÆUM*," September 23, 1876.

"Prof. Guthrie's note, 'On Solid Water,' was a description of what he formerly called 'cryohydrates,' aqueous solutions of various salts of such strength that when reduced to certain definite temperatures—all below 0° C.—the salt and the water solidify together. Surely there is nothing new in the fact of water becoming solid by associating with various compounds in their crystallisation? But of course a scientific man cannot go before the public at the British Association and not be sensational."

"September, 1876

"In the *Athenæum* for September 23 your reporter for the Chemical Section of the late meeting of the British Association, in noticing my communication on solid water as it exists in certain compounds, expresses himself as follows:—

"'Surely there is nothing new in the fact of water becoming solid by associating with various compounds in their crystallisation? But of course a scientific man cannot go before the public at the British Association and not be sensational.'"

"To the first part of this expression I have only to say that I did not, and do not, pretend to be the discoverer of water of crystallisation as it is ordinarily understood. A great many salts (Epsom salts, blue vitriol, alum, &c.) were known, before your reporter and I were born, to contain water; but others (sal-ammoniac, saltpetre, &c.)

were only known in the anhydrous state. Now, I do pretend to have discovered the facts, whatever their importance may be, (1) that all crystalloid bodies soluble in water are capable, at temperatures below 0°C ., of uniting with water to form solids containing definite quantities of water; (2) that the temperatures of solidification of these bodies, which I call cryohydrates, determine the limiting temperatures of freezing mixtures.

"With regard to the second part of your reporter's remark, namely, the accusation of sensationalism, I am constrained to say that it is as discourteous as it is unfounded, and I shall be glad to learn that, on reflection, your reporter regrets having allowed an expression of such questionable taste to have escaped him.

"FREDERICK GUTHRIE.

"* * * Prof. Guthrie admits that he does 'not pretend to be the discoverer of water of crystallisation as it is ordinarily understood.' Well, but this 'water of crystallisation as it is ordinarily understood' is *solid* water, and we were therefore quite correct in maintaining there was nothing new in this. We never said that Prof. Guthrie had not discovered various salts which could, under certain circumstances, be got to crystallise with water, but we only found fault with the designation, which includes much more than Prof. Guthrie himself claims to have achieved. Surely the giving of such a designation justifies the charge of sensationalism."

"September 30, 1876.

"The remarks appended in the *Athenæum* of the 30th inst. to my note on your report of my communication to the British Association on 'Solid Water,' call for a word or two. You say:—

"* * * Well, but this 'water of crystallisation as it is ordinarily understood,' is *solid* water, and we were therefore quite correct in maintaining there was nothing new in this."

"In what? That water of crystallisation as it is ordinarily understood is solid? Of course it is. I never dreamt of denying it. What I asserted, and conceive to be new, is that water may be solid and associated in definite proportions with salts, and yet not be water of crystallisation as it is ordinarily understood. It may either be such water or it may be the water of the cryohydrates. I used the term 'solid water' to include and because it includes both; and in my communication I spoke of both to discriminate between them. Can you suggest a more appropriate or less 'sensational' expression?"

"The charge of sensationalism, which I regret to see not only not withdrawn but reiterated, may sometimes be permissible when brought against a writer of fiction; but to bring it on no better grounds than those adduced, against a writer on a scientific subject is injurious and unjust. You owe me an apology.

"FREDERICK GUTHRIE.

"* * * We must decline to continue this controversy. There seems to be no difference as to facts between Prof. Guthrie and ourselves. We neither denied Prof. Guthrie the merit, if there be any, of having discovered the formation of solid water under particular circumstances, nor, as far as we are aware, have we imputed to him any desire of denying the existence of hydrates known before his researches. As to our suggesting a more appropriate designation for the class of bodies discovered by him—does Prof. Guthrie seriously believe this to be our concern? With regard to the title chosen by Prof. Guthrie for his paper at Glasgow, we have only to say that this is not a question of *fact* but of *taste*, and that upon it we shall continue to differ from Prof. Guthrie."

With a journal which, after transgressing in this manner, refuses to apologise when invited to do so I can, of course, hold no further communication. But your readers may permit me to state that there is no "controversy" in the case. I have endeavoured to inform the

Athenæum in matters of fact, and I have resented the silly little insult which it has presumed to put upon the members of the British Association. I may add that I do "seriously" think it is the "concern" of a critic who takes exception to an expression, not only to point out how the expression is bad—if he can—but also to suggest a better one—if he can. The first of these duties the *Athenæum* has attempted and signally failed to perform. The second it declines to attempt because, forsooth, it is not its "concern."

From the assertion that the difference between the reporter or editor or whoever he is of the *Athenæum* and myself is only one of taste I must beg to dissent; or only agree to so far as I must admit that the misrepresentation of facts exhibits the worst possible taste.

Although, of course, one has to be serious in remonstrating with a journal devoted to "English and Foreign Literature, Science, the Fine Arts, Music, and the Drama," there is something exquisitely ridiculous in the notion of "Solid Water" being a "sensational" expression. "Hard Water" I presume is "Indelicate;" "Cold Water" is clearly "Atheistic;" and "Vapour of Water" should be avoided on high æsthetic principles if we wish to avoid the imputation of "Cannibalism."—I am, &c.,

FREDERICK GUTHRIE.

PROF. DITTMAR AND THE "ANALYST."

To the Editor of the Chemical News.

SIR,—Had Mr. Wanklyn paused to make a few enquiries before writing to you, he would not, I am sure, have dragged my name into this discussion, because he would have found that at the time the *Analyst* published the article and report which originally gave him offence, I was enjoying a ramble in Switzerland, and I can safely say never wasting a thought either on butter or Mr. Dittmar. In fact Mr. Wanklyn and myself have precisely the same amount of responsibility for the contents of the *Analyst* for September, viz., that we were both members of the Committee of Publication, and that we each of us neglected our obligations as such, and stayed away from the meeting, and therefore we ought to be the last to throw stones at those who did their duty by attending.

My position as one of the "registered proprietors" of the paper was simply taken to get the Society out of the difficulty that, not being corporate, they could not legally hold a copyright, and I will have much pleasure in handing over the position (involving, as it does, pecuniary responsibility) to any other member who may be public spirited enough to accept it. I trust Mr. Wanklyn will withdraw his remarks so far as I am personally concerned.—I am, &c.,

JOHN MUTER.

South London Central Public Laboratory,
Kennington Cross, S.E., October 7, 1876.

ON THE PRESENCE OF ARSENIC IN THE VAPOURS OF BONE MANURE.

To the Editor of the Chemical News.

SIR,—The pamphlet published by Dr. Adams on the above subject has occasioned some discussion in the *CHEMICAL NEWS*, and in your number of September 22nd, there is a note which seems to suggest a doubt whether the chemists who made experiments for Dr. Adams had previously satisfied themselves of the purity of their reagents.

I may state that I was expected to give evidence in the particular case referred to in the pamphlet, and that I not only made "blank experiments" when originally consulted by Dr. Adams, but made them again in his presence when he came to my laboratory to see the experiments repeated.

Considering the abundant evidence adduced by Dr. Adams, I think it may reasonably be conceded that

arsenical vapours are given off during the action of arsenical sulphuric acid on bones or coprolites. On the medical question involved I have no opinion to offer.—I am, &c.,

ALEX. T. MACHATTIE.

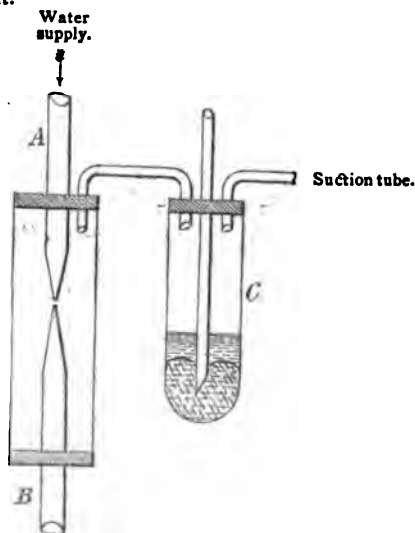
88, Hope Street, Glasgow.

[We have also received a long communication on this subject from Dr. Adams, and a further letter from Dr. Milne stating that blank experiments were made. This fact should, in our opinion, have been stated more explicitly in the book. We can devote no more space to the subject, it being contrary to our custom to insert letters referring to our reviews of books, unless, indeed, they point out a manifest injustice to the author, and this we do not admit to have been the case in the present instance.—Ed. C.N.]

IMPROVED FORM OF ASPIRATOR.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 141) Mr. Richards describes an "Improved Form of Aspirator." This is somewhat similar in principle to one I constructed about four months ago, the chief difference being that Mr. Richards's pump requires a water pressure of 20 pounds to the square inch to exhaust "to within 1 m.m. of the tension of aqueous vapour," while mine takes less than 5 pounds only to produce a vacuum (less, of course, by the tension of aqueous vapour.) I append a drawing of my arrangement.



The tubes A B are of glass, and placed diametrically opposite each other, so that the water issuing from the jet A passes smoothly down through B. C is a mercury governor, to regulate the pressure when the pump is used for filtering purposes. The rapidity with which this pump exhausts is very great.

The principle involved was fully discussed and illustrated in a paper to the *Engineer* of June 9, 1876, by Mr. James Brownlee.—I am, &c.

A. PERCY SMITH.

Rugby, October 2, 1876.

Action of Nitrous Acid upon Acetanilide.—Otto Fischer.—On passing a current of nitrous acid into a refrigerated solution of acetanilide in acetic acid until the liquid becomes green there is obtained, on pouring the solution into a large quantity of water, a yellowish precipitate which possesses the composition and characteristics of nitroso-acetanilide.—*Moniteur Scientifique*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 12, September 18, 1876.

Lighting by means of Products Extracted from Resinous Trees.—M. A. Guillemare.—The author remarks that if an attempt is made to burn in a common lamp, adapted for oil of colza or petroleum, either oil of turpentine, "essentia viva," or the oil known as pyrogene (the two latter being extracted from resin by fractional distillation over 4 per cent of quicklime), two difficulties are met with which have hitherto proved insurmountable. The resinous liquids of commerce only rise into the wick for a few minutes, after which the capillary action slackens considerably and soon stops. In all the lamps of commerce these same liquids burn imperfectly and diffuse an intense smoke. It is therefore needful to purify them perfectly, and to contrive a special jet or burner for their use. The clogging of the wick is due to the presence of resin or of naphthalen in solution. These impurities are removed by distillation over an equal volume of water rendered slightly alkaline, a current of steam being passed through the apparatus, and by exposing the oils to the direct and prolonged action of concentrated solutions of alkaline carbonates. The oils may be regarded as perfectly pure when they are no longer rendered milky by the addition of ammonia. A new burner has been devised, the construction of which is not quite clear, but which is said to prevent the formation of smoke.

Physical Properties of Gallium.—M. Lecoq de boudran.—Inserted in full.

Justus Liebig's Annalen der Chemie,
Band 182, Heft 3.

Investigations on Bodies of the Hydrobenzo and Stilben Series.—T. Zincke.—An introduction to the next paper.

Various Hydrobenzoinis, or Stilben Alcohols.—C Forst and T. Zincke.—A very bulky essay, extending 50 pages, and unfit for abstraction.

Apparatus for the more Convenient Determination of Nitrogen.—Karl Zulkowsky.—An improved instrument for the determination of nitrogen by the method of Dumas, calculated to be of great value in laboratories where such determinations are frequent. The apparatus cannot be described in an intelligible manner without the aid of the accompanying illustration.

On Ultramarine.—Dr. Carl Boettinger.—It has always been assumed that the formation of the blue colour of ultramarine depends on the action of oxygen: but in cracked crucibles and on the edges of the blue mass white products are often observed, which, on washing with water, lose almost all their sulphur in the form of sulphate. That this phenomenon is due to oxidation seems to require no further proof. Hence, then, it appears that the colour is destroyed by oxidation. In the author's opinion ideal ultramarine is a compound of silicate of alumina and soda with pentasulphide of sodium.

Communications from the Chemical Laboratory of the University of Moscow.—These communications include a paper by W. Markownikoff on isomeric tartaric acids, and one by the same author on the normal oxy-pyro-tartaric acid (glutanic acid), and the isomerism of the pyrocitric acids: an account of the preparation of trimethylen-bromide, by J. Lermontoff; on acetone in the urine of diabetic patients, by W. Markownikoff; on certain constituents of *Adonis vernalis*, by F. Linderos; and a preliminary communication on isomeric dibrom-anthracen, by Oswald Miller.

Contributions to the History of Betulin.—U. Hausmann.—The composition of betulin is—

Carbon	80.00
Hydrogen	11.11
Oxygen	8.89

100.00

corresponding to the formula $C_{12}H_{20}O$. In a state of purity it is colourless, and forms long slender prisms, which are readily converted by pressure into shining asbestos-like masses. It melts at 258° . At a slightly higher temperature it is volatilised with incipient decomposition, and sublimes in long delicate needles.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 4, September 28, 1876.

Adulteration of Wines.—The author remarks that so long as falsification consisted merely in heightening the colour of wines with logwood and other vegetable matters it was only a semi-evil, though still considerable enough, since one of the dyes most commonly used was a drastic purgative. But magenta has now come into use on a scale scarcely to be imagined. A small commune in the neighbourhood of Béziers, containing only 1800 inhabitants, has consumed in one year 30,000 francs worth of this colour entirely for sophisticating wines.

MISCELLANEOUS.

Birmingham and Midland Institute.—The following are the lecture arrangements for the session 1876-7:—

This day (Friday), October 13.—Lieut. Cameron, D.C.L., on "Recent Explorations in Africa."

October 16.—Captain Davis, R.N., F.R.G.S., on "Antarctic Discovery, and its Connection with the Transit of Venus, 1882."

October 23, 30.—Prof. W. C. Williamson, F.R.S., on "The Early Forms of Animal Life," and "The Early Forms of Vegetable Life."

November 6, 13.—George Dawson, M.A., on "Horace Walpole."

November 20.—Wm. Huggins, D.C.L., LL.D., F.R.S., on "Spectrum Analysis Applied to the Heavenly Bodies."

November 27, December 4.—Arthur Arnold, on "Persia."

December 11.—Prof. Boyd Dawkins, M.A., F.R.S., F.S.A., on "The Ancient Inhabitants of the Caves of Derbyshire."

January 22, 29.—E. Ray Lankester, M.A., F.R.S., on "Rots and Ferments, our Unseen Enemies."

February 5, 12.—Edward Dannreuther, on "The Pianoforte Works of Liszt and Chopin."

February 19, 26.—Prof. Sidney Colvin, M.A., on "Olympia and Greek Athletics; a Study of Ancient Usages and Recent Discoveries."

March 5.—Prof. J. M. D. Meiklejohn, M.A., on "Parody."

March 12.—Prof. Sir C. Wyville Thomson, LL.D., F.R.S., on "The General Results of the Challenger Expedition."

March 19, 26.—Prof. W. Barrett, F.R.S.E., on "Radiation and Radiometers."

April 9, 16.—George Dawson, M.A., on "Sir Walter Raleigh."

NOTES AND QUERIES.

* Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Fluoride of Potassium.—Can any of your readers give me a process for the ready production of fluoride of potassium.—FLUORINE.

An Analytical Query.—In separating arsenic, &c., from copper &c., by treating with an alkaline sulphide, I generally get the filtrate rather dark, and it seems to contain not copper in solution, but finely divided. I believe there is a way of preventing even a slight trace of copper getting through. I have looked at many analytical works but have failed to see anything about it, except the diluting, but that I have always done. I have taken in the *CHEMICAL NEWS* for years but have never seen anything on the subject.—ROBERT MONROE.

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OR, THE KEY TO MODERN CHEMISTRY.

By A. H. KOLLMYER, A.M., M.D.,

Professor of Materia Medica and Therapeutics at Montreal.

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Early in October.

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ALEX. MOORE, Secretary.

166, St. Vincent Street, Glasgow,
October, 11, 1876.

THE CHEMICAL NEWS.

Vol. XXXIV. No. 882.

ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

81. THE present paper is in continuation of one which I had the honour of reading before the Royal Society, December 11, 1873, and which was published in the *Philosophical Transactions*, vol. clxiv., part 2, p. 501. In that paper I described various pieces of apparatus, chiefly in the form of delicate balances suspended in glass tubes, by means of which I was enabled to show attraction or repulsion when radiation acted on a mass at one end of the beam, according as the glass tube contained air at the normal pressure, or was perfectly exhausted. At an intermediate internal pressure the action of radiation appeared nil. Towards the end of the paper I said (70), "I have arranged apparatus for obtaining the movements of repulsion and attraction in a horizontal instead of a vertical plane. Instead of supporting the beams on needle-points, so that they could only move up and down, I suspend them by the centre to a long fibre of cocoon silk in such a manner that the movements would be in a horizontal plane. With apparatus of this kind, using very varied materials for the index, enclosing them in tubes and bulbs of different sizes, and experimenting in air and gases of different densities up to Sprengel and chemical vacua, I have carried out a large series of experiments, and have obtained results which, whilst they entirely corroborate those already described, carry the investigation some steps further in other directions."

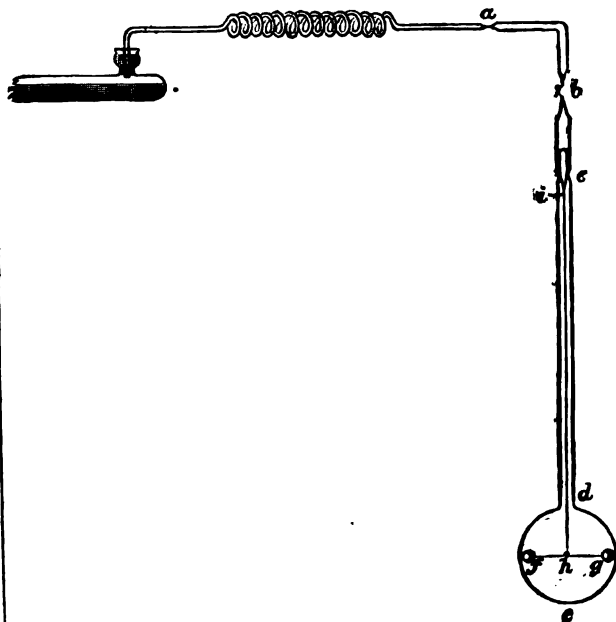
82. I have introduced two important improvements into the Sprengel pump† which enable me to work with more convenience and accuracy. Instead of trusting to the comparison between the barometric gauge and the barometer to give the internal rarefaction of my apparatus, I have joined a mercurial siphon-gauge to one arm of the pump. This is useful for measuring very high rarefactions in experiments where a difference of pressure equal to a tenth of a millimetre of mercury is important. By its side is an indicator for still higher rarefactions; it is simply a small tube having platinum wires sealed in, and intended to be attached to an induction coil. This is more convenient than the plan formerly adopted (51) of having a separate vacuum tube forming an integral part of each apparatus. At exhaustions beyond the indications of the siphon-gauge I can still get valuable indications of the nearness to a perfect vacuum by the electrical resistance of this tube. I have frequently carried exhaustions to such a point that an induction spark will prefer to strike its full distance in air rather than pass across the $\frac{1}{2}$ inch separating the points of the wires in the vacuum tube. A pump having these pieces of apparatus attached to it was exhibited in action by the writer before the Physical Society, June 20, 1874.

83. The cement which I have found best for keeping a vacuum is made by fusing together 8 parts by weight of resin and 3 parts of bees'-wax. For a few hours this seems perfect, but at the highest exhaustions it leaks in the course of a day or two. Ordinary or vulcanised india-rubber joints are of no use in these experiments, as when the vacuum is high they allow oxygenised air to pass through as quickly as the pump will take it out. Whenever possible the glass tubes should be united by

fusion, and where this is impracticable mercury joints should be used. The best way to make these is to have a well-made conical stopper, cut from plain india-rubber, fitting into the wide funnel tube of the joint and perforated to carry the narrow tube. Before fitting the tubes in the india-rubber, the latter is to be heated in a spirit flame until its surface is decomposed and very sticky; it is then fitted into its place, mercury is poured into the upper part of the wide tube so as to completely cover the india-rubber, and oil of vitriol is poured on the surface of the mercury. When well made this joint seems perfect; the only attention which it subsequently requires is to renew the oil of vitriol when it gets weakened by absorption of aqueous vapour. Cement has to be used when flat glass or crystal windows are to be cemented on to pieces of apparatus, as subsequently described (99, 102).

It would be of great service could I find a cement which is easily applied and removed, and will allow the joint to be subjected to the heat of boiling water for some hours without leaking under the highest rarefactions. Hitherto I have failed to find one which answers these requirements. I mention this in the hope that some one who happens to read this may be in possession of the recipe for such a cement, and will communicate it to me.

84. Before my first paper on this subject was read before the Royal Society I had discarded the balance form of apparatus there described, and commenced experimenting with bulbs and tubes in which quantitative results could be obtained. On December 11, 1873, when illustrating my paper, I exhibited to the Society many of these new forms of apparatus. For the purposes of simple illustrations, and for experiments where quantitative determinations are not required, I find a horizontal index suspended in a glass bulb the most convenient. The apparatus, with its mode of attachment to the pump, are shown in fig. 1.



a, b, c, d is originally a straight piece of soft lead-glass tubing 18 inches long, $\frac{1}{4}$ of an inch external and $\frac{1}{8}$ internal diameter. At one end is blown a bulb, d e, about 3 inches diameter. The part a b of the tube is drawn out to about half its original diameter, and bent at right angles. The tube is slightly contracted at c, and very much contracted and thickened at b. At a it is also contracted and cemented by fusion to a narrower piece of tube bent in the form of a spiral, and fitting by a mercury joint into the

* From the *Philosophical Transactions of the Royal Society of London*, vol. clxiv., pt. 2.

† *Philosophical Transactions*, 1873, vol. clxiii., p. 295; 1874, vol. clxiv., pp. 509, 516. *Phil. Mag.*, August, 1874.

sulphuric acid chamber of the pump. The object of the spiral is to secure ample flexibility for the purpose of levelling the apparatus, and at the same time having a fused joint. *fg* is a very fine stem of glass, drawn from glass tubing, and having a small loop (*h*) in the middle. At each end of the stem is a ball or disk, made of pith, cork, ivory, metal, or other substance. *hi* is a fine silk fibre made from split cocoon-silk; it is cemented by shellac at the upper end to a piece of glass rod a little smaller in diameter than the bore of the tube, and drawn out to a point, as shown. The contraction (*c*) in the tube is for the purpose of keeping this glass rod in its place; when properly adjusted it is secured in its place by a small piece of hot shellac, care being taken not to cement the rod all round, and so cut off the connection between the air in the bulb and that in the upper part of the tube. The silk fibre is tied on to the loop of the glass stem at *h*. The length of the fibre is so adjusted that the stem and disks will hang about $\frac{1}{2}$ of an inch below the centre of the bulb; that much having to be allowed for the contraction of the silk when the air is exhausted.

85. The bulb-tube is firmly clamped in a vertical position, so that the index hangs freely, and the pump is set to work, the bulb being surrounded with a vessel of water which is kept boiling all the time exhaustion goes on. The gauge soon rises to the barometric height; but the operation must be continued for several hours beyond this point in order to get the best effects. If the bulb is not heated during the exhaustion, the index loses sensitiveness after it has been sealed up for a few days, probably owing to the evolution of vapour from the pith; when, however, the precaution is taken of heating the pith the apparatus preserves its sensitiveness. On this account it is necessary to tie the silk on to the loop in the centre of the glass stem, instead of adopting the easier plan of cementing it with shellac. During the latter stages of the exhaustion, oil of vitriol (which has been boiled and cooled *in vacuo*) should gently leak into the pump through the funnel-stopper at the top of the fall-tube (44). This covers each globule of mercury as it falls with sulphuric acid, and stops mercury vapour from getting into the apparatus.* I cannot find that any vapour is evolved from oil of vitriol.

When the exhaustion is carried to the desired degree a spirit flame is applied to the contracted part of the tube at *a* (fig. 1), and it is sealed off. The apparatus is then unclamped and the tube is again sealed off at *b*. This double operation is necessary to secure strength at the final sealing, which can only be got by holding the tube horizontally and rotating it in the flame, watching the glass to prevent it softening too suddenly.

86. The best material of which to form the index in these bulb-tubes is pith, either in the form of a needle or bar, or as disks at the end of a glass stem. On December 11, 1873, and again on April 22, 1874, I exhibited before the Royal Society a glass bulb 4 inches in diameter, having suspended in it a bar of pith $3\frac{1}{2} \times \frac{1}{4}$ inches. It had been exhausted in the manner above described; and so sensitive was it to heat, that a touch with the finger on a part of the globe near one extremity of the pith would drive the bar round 90° , whilst it followed a piece of ice as a needle follows a magnet.

To get the greatest delicacy in these apparatus there is required large surface with a minimum of weight (75, 76). Thin disks of pith answer these requirements very satisfactorily; but I have also used disks cut from the wings of butterflies and dragonflies, dried and pressed rose-leaves, very thin split mica and selenite, iridescent films of blown glass, as well as the substances mentioned in my former paper (25). Quantitative experiments to prove this law were attempted; but the bulb apparatus was found too imperfect for accurate measurements, so another

form was devised which will be described further on (102), together with the experiments tried with it.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 149.)

Chlorine, Bromine, Iodine, and Fluorine.
By Dr. E. MYLIUS, of Ludwigshafen.

As leaden worms are very rapidly destroyed by liquid bromine, though very slightly attacked by bromine vapours, Frank† employs condensing tubes of earthenware. To separate the bromine from the chloride of bromine simultaneously evolved he avoids a too perfect refrigeration, and conducts the more volatile products, including the chlorine, into a receiver charged with iron-turnings or with potash-lye. The crude bromine in the first receiver is then completely freed from chlorine and from sparingly volatile organic bromides which are usually present by fractionated distillation.

Several methods for obtaining the bromides of the alkalies and alkaline earths deserve notice. Henner and Von Hohenhausen‡ prepare the bromides of calcium, barium, and strontium by diffusing the respective hydrates in water, decomposing with bromine, evaporating till the formation of crystals begins, and mixing the liquid with alcohol, which precipitates the last portion of the bromate formed. The bromide is then obtained from the liquid, and a further portion is procured by heating the bromate with charcoal. C. Wendler§ proposes to prepare the bromides of the alkaline earths according to Rud. Wagner's approved method for the manufacture of the corresponding iodides, i.e., by the action of bromine upon the sulphites.

According to A. Faust& Boedeker obtains the bromides as follows:—Bromide of sulphur is prepared from 20 parts flowers of sulphur and 240 parts of bromine, and gradually poured into the milk of lime made from 140 parts of quicklime, or into a corresponding solution of baryta. The bromide of sulphur in contact with the hydrate of the alkaline earth is decomposed into a metallic bromide and a sulphate. The latter is removed by the addition of alcohol and subsequently of lime. The solution of calcic or baric bromide can either be used for obtaining those salts, or for preparing the sodic, potassic, or ammoniac bromide by decomposition with the corresponding carbonate or sulphate.

Casthelaz¶ prepares bromide of sodium by forming, in the first place, bromide of ammonium by dropping bromine into liquid ammonia, and decomposes this by the addition of an equivalent quantity of caustic or carbonated soda.

Falieres points out** that iodine present in bromide of potassium may be removed by agitation with free bromine.

Of all these methods of preparing bromides, especially bromide of potassium, which is most in use, none is practised on the large scale. Either the ferrous-ferric bromide is decomposed by the addition of carbonate of potassa, or vapours of bromine are conducted into potash-lye, and the potassic bromate formed along with potassic bromide

* "Berichte über die Entwicklung der Chemischen Indurtrie Während des Letzten Jahrzehends."

† Private communication.

‡ Henner and Hohenhausen, *Dingl. Pol. Journ.*, clxiii., 1864, 221.

§ C. Wendler, *Wagner Jahresber.*, 1863, 291.

& A. Faust, *Archiv. d. Pharm.*, clxxii., 216. *Wagner Jahresber.*, 1867, 196.

¶ Casthelaz, *Monit. Scient.*, 1870, 65. *CHEMICAL NEWS*, 1870, No. 532, 58; and 547, 238. *Wagner Jahresber.*, 1870, 195.

** Falieres, *Wagner, Jahresber.*, 1872, 274.

* By adopting this precaution it is not difficult to raise the mercury in the gauge higher than that in the very perfect barometer by its side, the latter being somewhat depressed by the tension of mercury vapour.

is decomposed by ignition with charcoal powder. The preparation of bromide of potassium and the bromides of iron is conveniently combined with the manufacture of bromine. Since 1867 Franck condenses bromine in a set of three Woolff's bottles, the first of which, slightly cooled, receives liquid bromine, whilst the second contains bromide of potassium or ferrous bromide, and the third potash-lye or iron-turnings. The chloriferous bromine vapours escaping from the first slightly cooled receiver pass through the solution of bromide and are freed from their chlorine, in the place of which bromine escapes from the bromides and arrives in a pure state into the iron-turnings or the potash-lye contained in the third bottle, in which pure bromides are at once obtained.

We have already mentioned that a large proportion of bromide of potassium is obtained from the ferroso-ferric bromide. The manufacturers of bromide of potassium are not under the necessity of preparing the iron compound themselves from condensed bromine. It is obtained at the Stassfurt bromine works, and is sold in the form of a paste containing from 65 to 70 per cent of bromine. As it can be packed in vessels of stoneware and tinned iron and even in wooden casks, it is the most convenient form for the carriage of bromine, which, in the free liquid state, is difficult to pack and dangerous to convey.

(To be continued).

ACTION OF PHOSPHINE (PH_3) ON MERCURIC CYANIDE (HgCy_2).

WHEN pure phosphine is passed into a solution of HgCy_2 in water or alcohol the gas is absorbed, a pale yellow precipitate is formed, and hydrocyanic acid (HCy) is evolved. This yellow precipitate quickly turns black on warming or exposure to sunlight, with partial reduction to metallic mercury. The alcoholic solution yields a better product than the aqueous solution, the precipitate being of a much brighter yellow colour, and not decomposing quite so rapidly as that formed in the aqueous solution.

It is so sensitive to light that it was found impossible to dry it, even *in vacuo*, without change of colour in the superficial portions. After drying for thirty hours *in vacuo* over oil of vitriol, a sample had a surface-colour greenish black, the under part being still yellow. Quantitative analysis shows it to contain Hg, P, Cy, and H.

When heated in contact with the atmosphere it ignites at about 90°C ., undergoing a kind of smouldering combustion, a residue of phosphoric acid, mercury, and some difficultly combustible carbonaceous matter containing nitrogen, (probably "para-cyanogen") being left. When heated in tube a little cyanogen gas and a phosphuretted hydrogen are given off, a residue of mercury and phosphoric acid, with carbonaceous matter, remaining.

The substance is oxidised by nitric acid, but dilute HCl and sulphuric acid do not seem to affect it.

Carbon, hydrogen, and mercury combustions have given the following figures:—

	A. Per cent.	B. Per cent.
C	1.65	1.48
Hg	84.72	84.76
H	4.30 (?)	—
Phosphorus ..	5.47	—
Nitrogen	5.00 (nearly)	(soda-lime comb.)

W. R. H.

Royal College of Chemistry.

ARSINE AND MERCURIC CYANIDE.

A PRECIPITATE is also produced by arsine (AsH_3) in alcoholic solution of HgCy_2 , which has a red-brown colour, and is also rapidly affected by light, but not quite so easily as the phosphine compound.

The precipitate produced by arsine in the water solution of mercuric cyanide is very unstable, decomposing in a few hours into Hg and arsenious and hydrocyanic acids at the ordinary temperature. The precipitate is so finely divided that it passes completely through filter-paper. Stibine appears to be a still more energetic reducing-agent on mercuric cyanide than phosphine or arsine; a rapid stream of stibine (SbH_3), prepared from (Sb_2Zn_3), producing a precipitate of metallic mercury in either aqueous or alcoholic solutions.

W. R. H.

Royal College of Chemistry.

NEW METHOD FOR ASCERTAINING THE EXACT QUANTITY OF PURE ANTHRACEN CONTAINED IN CRUDE ANTHRACEN.

By MEISTER, LUCIUS & BRÜNING.

THE experience gained during the last few years with regard to anthracen testing has induced us to abolish our old test of October, 1873, and the appendix of 1874, and to issue a new and improved method, as follows:—

Take 1 grm. of anthracen, place it in a flask with condenser of 500 c.c. capacity, add to it 45 c.c. of glacial acetic acid, and heat to ebullition. To this solution (which is kept boiling) add, drop by drop, a solution of 15 grms. of chromic acid in 10 c.c. of glacial acetic acid and 10 c.c. of water.

The addition of the chromic solution should occupy two hours; after which the liquid is to be kept boiling for two hours longer, four hours being required to complete the oxidation.

The flask with its contents is to be kept standing for twelve hours, then mixed with 400 c.c. cold water, and again kept standing for another three hours.

The precipitated anthraquinon is now collected on a filter, and washed first with pure water, then with boiling dilute alkaline solution, and finally with pure hot water. The quinon is now washed from the filter into a dish, and dried at 100°C . It is then mixed in the same dish with ten times its weight of fuming sulphuric acid of 68°Baumé (sp. gr. 1.88), and heated to 100°C . for ten minutes on a water-bath. The quinon solution thus obtained is poured into a flat dish, and kept for twelve hours in a damp place to absorb water.

Then add 200 c.c. of cold water to the contents of the dish, collect the precipitated quinon on a filter, and wash first with pure water, then with boiling alkaline solution, and finally with pure hot water.

The anthraquinon is now placed in a dish, dried at 100°C ., and weighed. After volatilising the quinon by heating the dish, it is weighed, with the particles of coal and the ash.

The difference between the two weights gives the weight of anthraquinon obtained, and it is to be calculated in the usual manner into anthracen.

Hoechst, a. M., October, 1876.

Prize in Industrial Hygiene.—An offer of a medal in connection with this subject has been made by Mr. Benjamin Shaw, and has been accepted by the Council of the Society of Arts. The medal will be of the value of £20, and will be awarded every fifth year. The terms of the offer are as follows:—"For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means." The first award will be made in May, 1877. The latest date for receiving communications will be March 31, 1877.

* The increased quantity of water added ensures the complete precipitation of the anthraquinon, and the correction formerly made is no longer necessary.

NOTES OF WORK BY STUDENTS OF
PRACTICAL CHEMISTRY
IN THE
LABORATORY OF THE UNIVERSITY OF
VIRGINIA.

No. V.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.
(Continued from p. 149.)

(2.) *Chemical Examination of Füh-ling (Lycoperdon solidum) from China.* By J. L. KELLER, of Charlottesville, Virginia.

Among a number of interesting specimens which Mr. Justus Eck, of London, was kind enough to present, some two or three years ago, to the laboratory collections of this University, was one of this curious material, accompanied by the following extract in reference to it from the late Mr. D. Hanbury's "Notes on Chinese Materia Medica :"—

"Füh-ling; *Pachyma cocos*, Fries (*Fungi*); *Lycoperdon solidum*, Gronovius; Pé-fo-ling, Cleyer (*Med. Sin.*, No. 189), Tatarinov (*Cat. Med. Sin.*, pp. 2—23); Puntson; Indian Bread; or Tuckahoe. A very large remarkable substance resembling ponderous rounded tubers having a rough blackish brown bark-like exterior, and consisting internally of a compact mass of considerable hardness, varying in colour from cinnamon brown to pure white. These tuberiform bodies, which in weight vary from a few ounces up to several pounds, are found attached to the roots of fir trees, or sometimes buried in the ground of localities where firs no longer grow. They occur in South Carolina,* in some of the northern and western provinces of China, and in Japan. Their true nature is sufficiently perplexing. The older writers considered them to be a sort of China root (*Smilax*), a supposition which their outward appearance certainly favours, but which is immediately negatived when we find them to contain no trace of starch. Loureiro and Endlicher are content to describe them as tubers found upon the roots of fir trees. Other botanists have placed them among fungi; Gronovius and Walter in the genus *Lycoperdon*; Schweinitz in *Scleroticum*; Okur and Fries in *Pachyma*. The latest observations on the subject are some which were submitted to the Linnean Society by Mr. F. Currey and myself last year (1861) and published in the *Linnean Transactions*. The opinion there expressed is that these tuber-like bodies are an altered state of the root of the tree, probably occasioned by the presence of a fungus, the mycelium of which traverses, disintegrates, or even obliterates the wood and bark. This mycelium appears under the microscope in the form of fine threads usually more or less mixed with bodies of irregular shape, somewhat resembling starch granules, but which are apparently cells of the woody tissue in a more or less advanced state of disease and distortion. Nothing is known of the more developed form of the fungus represented by the mycelium. The American Füh-ling has been examined chemically by Professor Ellett, of South Carolina College, who has stated it to consist entirely of pure pectine of Braconnot, but I think its composition deserves some further investigation. I find that the pure white internal substance (which is quite insipid and inodorous) is very slightly soluble in cold rectified spirit and in cold water, and not more so when boiled in water, the solution in each case yielding a flocculent precipitate with acetate of lead. When boiled in a weak solution of carbonate of soda the substance dissolves rather more freely, and the solution affords a scanty gelatinous precipitate (pectic acid) when

treated with an acid, or (pectate of lime) with a solution of lime. In China the Füh-ling is made into edible cakes, which are frequently sold in the streets; it is also reported medicinal in a variety of disorders. In America it has also been used as an article of food, whence the name Indian bread."

The *Report of the U. S. Department of Agriculture for 1870* (p. 423), in an article upon materials used as food by the North American Indians, has the following notice of this substance :—

"*Tuckahoe or Indian Bread (Lycoperdon solidum).*—Two specimens of this fungus are in the collection of the Department of Agriculture—one from Nottoway Co., Virginia (fig. 1, plate 10), and the other from Leroy, Kansas (fig. 2, plate 10). These singular fungous growths are subterranean and parasitic on the roots of large trees. A piece of root is often inclosed in the mass. The form is irregularly globose, about the size of a man's head. It is very rugous and filled with cracks; the colour externally is ashy black, in the interior white or nearly so, of a starchy appearance, very firm, and breaks into irregular masses. The Kansas specimen is rounded in shape, with a black, rough exterior, and a white and compact interior. When broken it has the appearance of a mass of dried dough, full of fissures and very granular. Booth and Morfit's *Cyclopædia of Chemistry* gives the following under the article of 'Picquotaine,' a highly nutritious plant used as food by Indians. It results from a disease of the *Psoralea esculenta*. Its composition is as follows :—Nitrogenous matter, 4.09; mineral substances, 1.61; starch, 81.80; water, 12.50." The following remarks relative to the Tuckahoe are furnished by Dr. John Torrey :—"It was first brought to the notice of the public by Dr. Clayton, who sent it to Gronovius under the name of *Lycoperdon solidum* and as such described it in the *Flora Virginica* about one hundred and twenty years ago. Next it was described by the late Dr. von Schweinitz, in his "Synopsis of the Fungi of North Carolina," under the name of *Scleroticum cocos*. About the same time Dr. Macbride, of Charleston, South Carolina, sent to the Linnean Society of London his observations on that fungus. Without being aware of having been anticipated by Schweinitz I described it in the New York Repository about the year 1819, under the name of *Scleroticum giganteum*. I gave also a chemical analysis of it, showing that it is chiefly composed of a singular substance which I named sclerotine. Braconnot some years after this described the same principle, which he called pectine. In the *Synopsis Fungorum* of Fries, the fungus is called *Pachyma cocos*. In the *Proceedings of the Linnean Society of London* is an account by Rev. M. J. Berkeley of a large subterranean fungus that is sold as food in the streets of Shanghai, undoubtedly the same as the Tuckahoe."

And in the *Report of the same Department for 1871* (p. 98) occurs the following from R. T. Brown, Chemist to the Department :—

"*Tuckahoe or Indian Bread.*—This curious fungus (*Scleroticum giganteum*) is quite common in many parts of the Southern States, where it is frequently used as an article of food.* To determine its nutritive value a specimen from Columbia, Virginia, was subjected to careful analysis in this Laboratory, with the following results :—

"Moisture	14.16
"Glucose (fruit sugar) ..	0.93
"Gum	2.60
"Peccose	17.34
"Nitrogen in an insol. combination	0.36
"Woody fibre	64.45
"Ash	0.16

100.00

* They are by no means peculiar to this State. I have seen specimens found at various points from Virginia to Alabama on the Atlantic side of the country, and, as will be seen by the quotation from *Report of the Department of Agriculture*, they extend as far west as Kansas.

* This is certainly an over strong way of stating the facts. Specimens of the material in question are not very rare, and they are

"This analysis does not sustain the high reputation of this substance as a food material."

The substance received from Mr. Eck being from China, while all the above statements as to chemical composition refer to material from America, and these statements differing so widely from each other, it seemed well to make a new analysis, which was done by Mr. Keller.

The specimen of Chinese Füh-ling examined was kidney-shaped, about 6 inches in longest diameter, and 3½ inches in shortest, and weighed about two pounds and a quarter. The rough, brownish black, bark-like exterior was about an eighth of an inch thick, verging gradually into the perfectly white uniform mass inside. The whole was compact and firm, but easily cut with a saw, and the fragments, after removal of the exterior crust, shewed but little toughness and were easily crushed in a pestle and mortar. A sufficient quantity was reduced to fine powder, passed through a sieve, and thoroughly mixed. This powder yielded little soluble matter to either cold or hot water, but was much more freely dissolved by a dilute solution of hydrate or carbonate of sodium, the liquid produced in each case giving a flocculent gelatinous precipitate (corresponding in character to peptic acid) when treated with an acid or alcohol, such precipitate proving excessively difficult to wash. Starch and cane-sugar were carefully tested for, but none could be found.

The quantitative analysis was made as follows:—Water was determined by prolonged exposure to 110° C.; albuminoid matter was calculated from the amount of nitrogen, determined by combustion with soda lime. For the organic matters soluble in water the powder was exhausted with water by repeated boiling, keeping the flask full of steam so as to exclude air; the liquid rapidly filtered, and evaporated (in a retort exhausted by a Bunsen's pump) to a small bulk. The solution was then divided into two parts, continuing the evaporation of the one to dryness at 100° C., weighing the residue as soon as it ceased to lose moisture, incinerating, and weighing the ash left; while the other was separately evaporated to dryness, exhausted with dilute alcohol (which took up a little glucose), and the residue dried at 100° C. and weighed; this being burned and the weight of ash plus the previously determined weight of albuminoid matter deducted, the quantity of gum was found by difference. In the dilute alcoholic solution glucose was determined by Fehling's copper solution. The pectous material was dissolved out from what water had left by repeated boiling with a dilute (1½ per cent) solution of sodium hydrate, and precipitated by dilute sulphuric acid and alcohol, but it was found to be almost impossible to wash the slimy precipitate, and it could not have been relied upon as unaltered in weight from the original insoluble pectous material, so that this was estimated by difference. The cellulose left undissolved by the sodium hydrate was treated with very dilute sulphuric acid (in the cold and for a short time only), then thoroughly washed with water, thrown on a weighed filter, dried at 100° C., and weighed; after burning the weight of the ash was deducted. The results were:—

Glucose	0.87	Org. matter—	
Gum (with a trace of acid) ..	2.98	Sol. in water	4.63
Albuminoid matter	0.78		
Pectose	77.27	Org. matter—	
Cellulose	3.76	Insol. in water	81.03
Mineral matter, sol. in water	0.08	Ash	3.64
" insol. in water	3.56		
Water	10.70	Water	10.70
	100.00		100.00

These figures, especially if taken in connection with Mr. R. T. Brown's results, are strongly suggestive of the

occasionally eaten by the negroes of the Southern States, but the substance can by no means be said to be common, or commonly used as an article of food. In the analysis there is obviously a little error of statement in reporting elementary nitrogen and accounting for all that remains of 100 per cent in non-nitrogenous material.

correctness of the opinion of Messrs. Hanbury and Currey as to the general nature of the substance, viz., that it represents woody fibre altered by the interpenetration of a fungus mycelium. In the specimen analysed by the Chemist of the Agricultural Department the alteration seems to have been incomplete, leaving a good deal of unchanged cellulose; in the case now under notice the cellulose has nearly disappeared. The very small amount of nitrogen renders the notion of the whole mass being simply an independent and developed fungus very unlikely.

Mr. Keller also made an analysis of the ash, to obtain which about 100 grms. of the substance was incinerated at a very low temperature in porcelain crucibles placed each within another of sheet iron serving as a hot-air bath. The ash was tolerably free from remaining charcoal. Chlorine, carbon dioxide, and silica were determined from the whole amount used; and after dividing the solution into two portions, sulphuric oxide and the alkalis were obtained from the one, and phosphoric oxide, ferric oxide, lime, and magnesia from the other. The analysis afforded:—

Crude Ash.		Pure Ash.	
K ₂ O	2.062	(Deducting Sand, Charcoal, and Carbon Dioxide.)	
Na ₂ O	0.967	K ₂ O	4.675
CaO	2.280	Na ₂ O	2.192
MgO	5.017	CaO	5.169
Fe ₂ O ₃	5.208	MgO	11.375
P ₂ O ₅	8.725	Fe ₂ O ₃	11.808
SiO ₂	0.700	P ₂ O ₅	19.781
Cl	0.724	SO ₃	1.587
SiO ₂	18.424	Cl	1.642
CO ₂	2.813	SiO ₂	41.771
Charcoal	2.209		
Sand	50.546		
	99.675	Deduct O equiv. to }	100.000
Deduct O equiv. to }	0.163	Cl }	0.370
Cl }			99.630
	99.512		

The large amount of sand is not caused by want of care in removing the exterior portions of the mass. With a lens sparkling little siliceous grains can be detected on a perfectly clean cut surface of the interior. This again accords with the idea of a fungoid growth pushing its way in a sandy soil into disintegrating woody tissue, and cannot at all be conceived of as a result of simple independent vegetable growth. Part of the large percentage of silica found to be soluble, and perhaps of the iron also, may very likely be also mechanically derived from the soil, but how much we have no means of determining.

(To be continued.)

South African International Exhibition, 1877.—An International Exhibition will be held in Cape Town in 1877, in a building to be erected for the purpose, by consent of the Colonial Government. It will include manufactures of all kinds. The date fixed for the opening is February 15, and everything intended for the Exhibition must be shipped from London not later than during the first week in December, 1876. Intending exhibitors should communicate immediately with Mr. Edmund Johnson, Commissaire Délégué, at the European Central Offices of the Exhibition, 3, Castle Street, Holborn, London. The Exhibition will be arranged in the following classes:—Class 1.—Alimentation. Class 2.—Chemicals, perfumery, medicines, and surgical appliances. Class 3.—Furniture. Class 4.—Fabrics, clothing, watches, jewellery, ornaments, precious stones. Class 5.—Means of transport, travelling equipments, harness, saddlery, &c. Class 6.—Hardware, edge tools, cutlery, metal work of all kinds. Class 7.—Machinery, materials, and construction. Class 8.—Agricultural, &c. Class 9.—Science and Education. Class 10.—Miscellaneous.

THE HYGIENIC CONGRESS AT BRUSSELS.

THE inauguration meeting of the *Congrès International d'Hygiène et de Sauvetage* took place at the Palais des Académies on the 27th ult., His Majesty the King of the Belgians being present. Lieut.-General Renard welcomed the Foreign Members of the Congress. M. Vervoot then delivered his Inaugural Address.

The Congress was divided into three sections, viz.—Hygiene, Saving of Life, Social Economy. The English Committee was constituted as follows:—

President.—Capt. Douglas Galton, C.B., F.R.S.

Hygiene.—Presidents, Mr. Edwin Chadwick, C.B., and Dr. Richardson, F.R.S., &c; Vice-Presidents, Dr. Hardwicke and Mr. H. H. Collins; Secretaries, Mr. J. S. Phené and Mr. J. W. Pearse.

Saving of Life.—Presidents, Sir Henry Verney, Bart., and Mr. William Crookes, F.R.S., &c; Vice-Presidents, Surgeon-Major Pater and Mr. G. M. Cooke; Secretary, Major Burgess.

Social Economy.—President, Mr. John Siltzer; Vice-President, Mr. Willis Bund; Secretary, Mr. John Russell, M.B.

The questions discussed in the first section included the following:—"What are the advantages of the distribution of population? Discuss the inconveniences which result of water, and what are the means for conveying it to the centres from taking water from the hydrographic basin. State the normal consumption per head of the inhabitants."

"Which is the most practicable system for ridding a town of its fœcal and putrescible matter and of its mud? Indicate the means (a) to purify sewage; (b) to utilise the drainage; (c) to prevent the contamination of water-courses by the refuse from factories; (d) to neutralise the noxious effects of dung-heaps in the proximity of dwellings, and to determine the circumstances which should regulate the choice of disinfectants and antiseptics."

In the second section the fifth question was—"What are the means of preventing explosions and flooding in mines, and of lessening their effects? Indicate the most secure means of lighting mines."

In the third section the first question was—"Determine the best arrangements, from a moral and hygienic point of view, for private dwelling-houses. Describe and examine the situation; the methods of heating, ventilation, and lighting; the means of supplying drinking-water and water for domestic uses; the systems of drainage."

A report on water-supply was read by M. Zimmer.

In the discussion which followed the report M. GERARDIN contended that water was good if animals could live in it; that the higher the organisation of the animal life the purer would be the water. He did not consider the quantity of mineral salts had much influence, whilst the presence of organic matter was fatal to the infusoria. Water from different sources ought not to be mixed.

M. VANDENSCHRIEK believed that 200 litres per diem for each individual was an unnecessary quantity. Formerly, only 20 litres were allowed per head, and yet epidemics were not so numerous nor so fatal at that epoch as in the present day.

M. BERGÉ pointed out (1) that the town of Brussels had a water-supply dating from Joseph II. (2) That it had been proved that organic matters only are hurtful; that it was known that water charged with lime and with chloride of calcium killed the fish; that chemical analysis was necessary to determine the quality of water. (3) That it was not yet proved that the mixing of two good waters was injurious.

With regard to the distribution of water, Captain DOUGLAS GALTON was in favour of constant supply without cisterns in preference to the intermittent supply by cisterns.

The COUNT TORELLI thought the determination of the quantity of water per head to each inhabitant very difficult, and varied naturally with the climate and the various conditions of the population.

M. VARRRENTAP pronounced against all waters obtained from the towns themselves.

M. T'SERSTEVENS insisted that water ought to be obtained from places thinly populated; where the soil is barren and the water superabundant.

M. DELVE advocated the periodical inspection of cisterns.

The papers on the sewage question included one by Mr. Crookes, who described the A B C process of purifying and utilising sewage.

The programme of the conferences included a paper by M. L. Derote, Engineer of Bridges and Roads, on the conclusions of the report of the English Rivers Pollution Commissioners, so far as it concerns the oxygenation of contaminated waters; and on the purification of the Senne and the drainage works of the town of Brussels executed under his (M. Derote's) direction.

Full reports on each subject brought before the Congress are being prepared, and will shortly be printed.

The King of the Belgians has offered a prize of 5000 francs to that city, local authority, or private association which shall, by improvements in the dwellings of the working classes effect the greatest reduction of the death rate at the lowest cost. The prize will be awarded at the next International Hygienic Congress, which will probably be held in 1878.

NOTICES OF BOOKS.

Annual Report of T. P. Yates, Commissioner of Agriculture of the State of Georgia for the Year 1875.

THIS issue contains a judicious and temperate reply to the sweeping objections often raised against the analysis of soils as of little value in pointing out their properties. We should scarcely, however, give in our adhesion to the view that fluorine, small as are the proportions in which it occurs, is of no value.

A curious instance is given of a soil which appears to have been cropped continuously for about ninety years without ever having been manured. The subsoil was originally very rich in plant-food, but its valuable ingredients have been greatly reduced in quantity.

The cultivation of cotton is considered very unremunerative, and farmers are recommended to turn their attention, in preference, to wool-growing. There is, however, a difficulty in the way: 15 per cent of all the sheep in the State are destroyed by dogs, which in the United States are a greater nuisance than even in Europe.

The Report generally may be pronounced full of valuable matter, but by far the greater portion of this is of an economical rather than of a chemical character.

Sydney City and Suburban Sewage and Health Board: Seventh, Eighth, and Ninth Progress Report of the Board appointed on April 12th, 1875, to inquire into and report as to the best means of disposing of the Sewage of the City of Sydney and its Suburbs. Sydney: Thos. Richards.

WHEREVER mankind congregate in great numbers the sewage question, sooner or later, forces itself upon their attention. Believers in *laissez faire* may for a short time shut their eyes to polluted streams, and affect not to perceive the evil odours that hover around them. But in the long run erysipelas, typhoid fever, diarrhoea, and perhaps cholera, speak in a language which cannot be misunderstood, and action is taken, but frequently when too late. Rising communities, whether in the British colonies or in the United States, cannot too early set about combatting the inevitable evil. The longer the needful measures are delayed, the costlier and the less efficient they will prove. Australia has hitherto enjoyed a remarkable immunity from zymotic diseases, but if fever is once introduced

its complete expulsion may not prove easy. The Sydney authorities do not seem favourably disposed towards irrigation. It must be admitted, on the one hand, that in comparatively dry a climate as that of Australia this method of dealing with sewage seems more feasible, from an economical point of view, than under the cloudy and drizzling skies of England; but, on the other hand, the danger to health will undoubtedly rise with the average temperature. We scarcely understand the precipitation scheme recommended at Sydney. The material to be employed is the carbonaceous residue from certain shales employed in the manufacture of kerosene oil. We can readily see how this matter might form a useful filter-bed, or how it might be employed as an adjunct in a precipitation process; but we are not aware that it contains any principle capable of acting as a true precipitant.

*Practical Manual of Chemical Analysis and Research applied to the Arts and Manufactures.** By P. A. BOLLEY and E. KOPP. Second French Edition, revised and enlarged. Translated from the Fourth German Edition, by Dr. L. GAUTIER. Parts 3 and 4. Paris: F. Savy.

This Manual is more extensive in its scope than any similar work in the English language. With the exception of purely pharmaceutical products it embraces every class of substances which are likely to fall into the hands of the commercial analyst or the "works-chemist." But as the entire book does not greatly exceed one thousand pages, we need not be surprised if some bodies are disposed of rather briefly, whilst others are treated at a disproportionate length. Thus alcoholic liquids occupy nearly one hundred pages, whilst soils and manures—which in this country certainly occupy a much larger share of the attention of analytical chemists—take up merely forty-two. In treating of the determination of phosphoric acid in manures and phosphatic minerals, the authors declare their conviction that of all known methods the molybdic acid process alone is capable of a general application, and yields results really trustworthy. All the other methods described, gravimetric or volumetric, are inexact or very tedious, on account of the presence of iron or alumina. The authors decide, contrary to the view of Birnbaum and Chojnacki, that nitric acid cannot be safely used as a solvent in the analysis of mineral phosphates, as notable quantities of phosphoric acid remain undissolved in the residue. They recommend hydrochloric acid when the presence of iron in the solution can occasion no difficulty, as when the molybdic method is to be used. In other cases Graham's solvent—sulphuric acid diluted down to 5 per cent of the monohydrate—may be advantageously employed.

For determining "reverted" phosphoric acid in manures they prefer the indirect method—ascertaining the total phosphoric acid insoluble in water, and deducting from this quantity the phosphoric acid insoluble in citrate of ammonia.

In treating on aræometry the authors strongly recommend Twaddle's hydrometer, in preference to those of Baumé and Beck, so much employed upon the Continent, and which are as devoid of any rational foundation as is the English system of weights and measures.

In the examination of magenta for sugar—an occasional adulteration—it is recommended to withdraw the colouring matter from the solution by means of wool or silk, or to precipitate it with common salt. The sugar then remains in solution, and may be easily recognised, and, if needful, determined.

The directions for the examination of lac-dye are somewhat insufficient. For certain uses, as in dyeing stuffs which require to be hot-pressed, it is very important that lac-dye should contain a minimum of gum-lac, for the approximate estimation of which the authors give no in-

structions. In treating of cochineal and indigo no allusion is made to the specific gravity of the samples, the determination of which is an easy and rapid way of detecting mineral impurities, whether accidental or intentional. Light cochineals and indigos may certainly be bad, but heavy ones cannot be good. Flavin appears to have been entirely overlooked, and the extracts of the dye-woods are spoken of merely in the solid state in which they are so often met with on the Continent, and not in the liquid form prevalent in England. The preparation of extracts, we may here observe, is one of the branches of manufacturing chemistry in which England is now not holding her own. Very considerable quantities both of French and American extracts are now used in Lancashire.

The tables showing the reactions of colouring-matters—natural, artificial, and when fixed upon textile fibres—are very complete. As regards the coal-tar colours, the authors have in many instances taken the useful precaution of giving the name of the manufacturer, often the only method of identifying the exact substance in question.

The least satisfactory portion of the work is the section on milk, which is altogether out of date, and in which much space is devoted to those deplorable instruments the lactometer and the creamometer.

The book will form a useful addition to the library of reference of the analytical chemist.

CORRESPONDENCE.

ROSE COLOUR OBSERVED IN THE MANUFACTURE OF CHLORATE OF POTASH.

To the Editor of the Chemical News.

SIR,—The following facts may throw some light upon the origin of the "rose" or red-violet colour observed in the course of manufacture of chlorate of potash, as noticed in Dr. Hofmann's "Report" &c. (CHEM. NEWS, vol. xxxiv., p. 139). Nearly all commercial samples of chloride of lime give, when boiled with distilled water, a splendid violet-red solution; on filtering through paper the colour disappears, and the paper is stained brown: if it be removed from the funnel, washed from adhering chloride of lime, and moistened with pure strong hydrochloric acid, the stain disappears, and a yellow solution is formed, which gives the characteristic iron-reactions with ferrocyanide and sulphocyanide of potassium. The purple solution may be obtained clear by subsidence, and may then be drawn off with a pipette; it may be evaporated nearly to dryness on the water-bath without decomposition, but on applying a somewhat stronger heat, to drive off the last traces of moisture, the coloured compound is decomposed, and the mass acquires a brown tinge.

If alcohol be added to the clear coloured solution a blue shade is first developed, and afterwards the colour gradually fades into a faint brown.

To determine the question of the presence of manganese, one drop of the coloured solution was placed on white filtering-paper, which was then dried on the water-bath; a brown stain appeared where the liquid had been: this was cut out, and divided into two parts; one of them was moistened with hydrochloric acid, and drops of ferrocyanide and sulphocyanide of potassium placed on opposite sides of the moistened portion; strong iron reactions were obtained in each case.

The other portion of the stained paper was incinerated and fused on platinum-foil with a little carbonate of soda; no trace of the manganese reaction could be observed with this most delicate test.

It is evident, therefore, that in the case in question the colour of the solution of chloride of lime is due to iron, not to manganese, and it would seem most probable that

* "Manuel Pratique d'Essais et de Recherches Chimiques appliqués aux Arts et à l'Industrie."

the coloured compound is a lime-salt of ferric acid: this would account for the appearance of the colour where Deacon's process for the preparation of chlorine is used, since traces of iron could hardly be excluded from any process of chlorine manufacture.

It is to be noted that no colour is produced where the "chloride" is exhausted with cold water; a temperature at or near the boiling-point is necessary to the appearance of the phenomenon.—I am, &c.,

THOS. P. BLUNT, M.A. Oxon., F.C.S.

Tower Place, Shrewsbury,
October 3, 1876.

DETERMINATION OF GOLD IN PYRITES.

To the Editor of the Chemical News.

SIR,—In reply to "Assayer" on the above subject, I did not propose iron turnings myself, but simply gave the most convenient method for obtaining the gold from the mineral, as it had then been treated. And now, as "Assayer" will perceive, the deoxidising process still holds good in all cases.—I am, &c.,

October 9, 1876.

LATENT.

PROF. DITTMAR AND THE "ANALYST."

To the Editor of the Chemical News.

SIR,—Referring to a letter which appeared in the *CHEMICAL NEWS* (vol. xxxiv., p. 151), signed by Mr. Wanklyn, we ask your permission to make a short statement as follows:—We beg to say that we are members of the Committee of Publication of the *Analyst*; that we consider we have devoted a fair amount of attention to our duties; that we have no wish to shirk our responsibility for anything that has appeared in the *Analyst*; and consequently we are in a position to deny—as we hereby emphatically do—Mr. Wanklyn's assertion that two other members of the Committee of Publication "alone are responsible for the contents of the paper."

Whatever may be Mr. Wanklyn's view of the duty of anyone holding office, we for ourselves can say that unless we felt ourselves both able and willing to perform our share of the duties of the Publication Committee of the *Analyst* we would certainly not allow our names to be published as members of that committee.—We are, &c.,

CHAS. HEISCH.
A. DUPRÉ.

October 9, 1876.

BLOWPIPE ANALYSIS OF THE NEW MINERAL HENWOODITE.

To the Editor of the Chemical News.

SIR,—Under the above heading (*CHEM. NEWS*, vol. xxxiv., p. 156) Major Ross gives an account of his examination, by his new methods, of Henwoodite. The following passage occurs in his article:—

"(6.) Heated another piece of (1), with pure oxide of lead, on a charcoal mortar on aluminium plate. Fused with great effervescence to a crystalline mass of plumbic phosphate, with minute balls of copper interspersed. (This new test for cupric phosphate is best seen with *Libethenite*: the copper disengaged seems beautifully pure.)"

This is a very interesting and characteristic reaction, but it is most certainly not new, as Major Ross asserts it to be. On the contrary, it is very old, and very well known to everybody who has practised the use of the blowpipe to any extent. If Major Ross will obtain a copy of Plattner's book on the Blowpipe, he will find the test fully described (the copy now before me is the German edition of 1865), and learn that it was given first by Berzelius.

It was taught to every student at Freiberg, and I have seen it used very frequently there and elsewhere. It is certainly new to use oxide of lead for the test, the usual method being to fuse the mineral with a piece of metallic lead. The use of oxide serves no good purpose, and has no object whatever; it only increases very unnecessarily the "great effervescence" of which Major Ross speaks.

It is quite correct of Major Ross to state that the test is best seen with *Libethenite*; and if he will look under that mineral in Dana's "Mineralogy" he will find the reaction fully described.—I am, &c.,

H. M. W.

HENWOODITE.

To the Editor of the Chemical News.

SIR,—Allow me to write a few lines in reply to Major Ross's remarks on my blowpipe experiments with Henwoodite. He says that by the methods I employed "the iron present is not detected at all." The reason I did not find any iron is simply this—there was probably none present. I took great care to use very pure fragments of the mineral, examining each one minutely with a lens before testing it; and my friend Mr. J. H. Collins informs me that when he tested some pure specimens with sulphocyanide of potassium, he was unable to detect the presence of iron. Major Ross admits that his specimens, even after his beginning to test them, were mixed with Göthite (? Limonite), and I cannot help surmising that the iron he detected was simply a mechanical impurity. Had there been much iron present I should not have obtained a blue bead with borax (cold). Besides, the precipitate with ammonia would have revealed its presence.

I cannot lay claim to the "great sagacity" with which Major Ross credits me for suspecting the presence of P_2O_5 in Henwoodite. The association of that mineral with Chalkosiderite, a hydrated phosphate of iron and copper, and its globular form, would naturally lead any mineralogist to test for phosphoric acid.

One word more:—Major Ross's "new test for cupric phosphate" seems to me to be merely a modification of Berzelius's good old method, which has been known for more than fifty years.* Berzelius used metallic lead, which is found in every complete blowpipe case, whilst Major Ross employs the oxide. The new method requires an additional, and it appears to me unnecessary, reagent.

In conclusion, let me assure you that I would not on any account undervalue Major Ross's labours; on the contrary, I congratulate him on having discovered many new and original tests in the too much neglected art of blowpipe analysis.—I am, &c.,

CLEMENT LE NEVE FOSTER.

Truro, October 16, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 13, September 25, 1876.

Probable Consequences of the Mechanical Theory of Heat.—M. Le Général Favé.—The substance which fills space, and which we call ether, without knowing whether it is simple or multiple, transmits the solar heat to the planets. This heat is a vibratory movement which the ether communicates to ponderable matter, and which has a speed of translation so considerable that we may ask if the heat coming from the sun does not exert a re-

* Berzelius, "Anwendung des Löthrohrs," p. 164. Nürnberg, 1821.

pulsive force upon each planet. Transparent bodies are traversed by radiant heat in a greater or less degree. That is, the vibratory movements of the ether intercommunicate in the whole interior of the transparent body without being transmitted, at least directly to the ponderable matter. Thus, transparent bodies are constituted with ether interposed in their interstices. It is known that a body which has passed from the solid to the liquid state, or from the liquid to the gaseous, has absorbed latent heat, and yet the molecules doubtless have not changed their vibratory speed when the solid, liquid, or gas have been brought to the same temperature. What, then, is the latent heat, that is to say, the movement insensible to the indications of the thermometer? We believe that everything may be explained; that the liquid contains, to a larger degree than the solid, interposed ether, which vibrates in unison with the ponderable matter. On this hypothesis, the gas would contain yet more constitutive ether than the liquid. The transparency of liquids, and the facility with which gases give passage to radiant heat, are facts favourable to this explanation.

Photo-micrographic Researches on the Effects of the Reduction of Salts of Silver in Photographic Proofs.—M. J. Girard.—On examining under a strong magnifying power a negative proof developed indistinctly with sulphate of iron or pyrogallic acid, we remark almost invariably in the light portions not acted upon, crystals uniformly disseminated, scarcely 1-100 of a m.m. in size. These crystals of reduced iodide of silver, sometimes very abundant, are the cause of frequent failures, as they form a cloud impervious to light.

New Process for the Extraction of Gallium.—M. Lecoq de Boisbaudran.—The ore, according to its nature, is dissolved in aqua regia, hydrochloric or sulphuric acid. The cold liquid is treated with plates of zinc, and filtered, when the escape of hydrogen is still considerable. The liquid is then heated with a large excess of zinc. The gelatinous deposit is washed, and redissolved in hydrochloric acid. The new liquid is heated with an excess of zinc, and a second gelatinous precipitate is obtained. Into the hydrochloric solution of this second precipitate formed by zinc a current of sulphuretted hydrogen is passed, the liquid is filtered, the excess of sulphuretted hydrogen driven off, and it is fractionated with carbonate of soda, ceasing when the ray G_{aa} 4170 ceases to be visible with the hydrochloric solution of the precipitate. The oxides or sub-salts are taken up with sulphuric acid; the solution is carefully evaporated until white sulphuric acid vapours are no longer, or but slightly, given off. It is let cool, and stirred with water, which dissolves the mass after the lapse of a time varying from some hours to a couple of days. The solution of the sulphate almost neutral is diluted with much water, and raised to a boil. The sub-salt of gallium is separated by filtration whilst hot. This basic salt is dissolved in a little sulphuric acid, and the liquid is mixed with a slight excess of caustic potassa, so as not (?) to dissolve the gallium, but to leave the iron. It is filtered, and the oxide of gallium is precipitated by a prolonged current of carbonic acid. This oxide is re-dissolved in a minimum of sulphuric acid, a slight excess of acetate of ammonia, feebly acid, is added, and it is then treated with sulphuretted hydrogen. Under these conditions the gallium is not precipitated. The acetic liquid is filtered, diluted with water, and raised to a boil. The bulk of the gallium is precipitated and filtered whilst hot. The mother-liquor, concentrated, and boiled with aqua regia in order to destroy ammoniacal salts, is added to the other gallium residues. The precipitate formed on heating the acetic liquid is re-dissolved in sulphuric acid, a slight excess of caustic potassa is added, and it is then filtered. The potassic solution is electrolysed. The gallium is easily detached from the sheet of platinum on pressing it between the fingers under warm water. The metal is then immersed for about half an hour in nitric acid at about 60° or 70°, quite free from

chlorine, and diluted with an equal volume of water. After washing it may be regarded as pure.

Moniteur Scientifique, du Dr. Quesneville,
September, 1876.

Anthraflavic and Iso-anthraflavic Acids.—MM. E. Schunck and H. Roemer.—These authors have announced in an earlier memoir the discovery of an acid isomeric with the anthraflavic, to which they have given the name of isanthraflavic acid, and which is prepared as follows:—The crude material prepared by Mr. Perkin is obtained on precipitating with hydrochloric acid a solution derived from the treatment of crude alizarin with lime-water. It is first separated from anthraquinon by dissolving the precipitate in dilute soda-lye: the filtrate yields, on the addition of hydrochloric acid, a yellow precipitate, which is partly dissolved in cold baryta-water. The blood-red solution is precipitated by acids in green flocks, turning red. This precipitate, if repeatedly crystallised from alcohol, gives a substance which forms yellow needles, and which, if dried at 150°, yields on analysis the following results:—

	Found.	Calculated for $C_{14}H_8O_4$.
C	69.79	70.00
H	3.62	3.33

Isoanthraflavic acid crystallises with water; a portion evaporates on desiccation over sulphuric acid, but the crystals preserve their lustre unless heated to 120°. The authors have also analysed the barium salt which corresponds to the formula $C_{14}H_8BaO_4$.

Anthraflavic Acid.—The portion insoluble in cold baryta-water (see above) is composed of anthraflavic acid. The barium salt of this acid closely resembles the corresponding salt of isanthraflavic acid, but it is insoluble. It crystallises with two molecules of water, and is gradually decomposed on exposure to the air.

Properties of Isoanthraflavic and Anthraflavic Acids,
Isoanthraflavic Acid. Anthraflavic Acid.

Crystallises from aqueous alcohol with crystalline water.	Crystallises without water.
Melting-point above 330°.	Ditto.
Less soluble in glacial acetic acid than in alcohol.	Ditto.
Almost insoluble in benzol, chloroform, and ether.	Ditto.
Soluble in hot concentrated sulphuric acid with a deep red.	Soluble in concentrated sulphuric acid with a yellow.
Easily soluble in cold baryta-water.	Insoluble in cold baryta-water.
Easily soluble in lime-water.	Soluble with difficulty in cold lime-water, and less soluble at a boil.
Carbonic acid throws down anthraflavic acid from the aqueous solution of the barium salt, but the salt is re-formed on ebullition.	Ditto.
Soluble in alcoholic lead acetate.	Ditto.
The solutions in alkalies and alkaline earths are of an intense red.	The solutions in alkalies and alkaline earths are more or less tinged with reddish yellow.
Sublimes in brilliant yellow needles and leaflets.	Ditto.
Is not fixed by mordants.	Ditto.

The authors have examined the tetrabromated isoanthraflavic acid, the corresponding anthraflavic compound, and the diacetylic, diethylic, and dimethylic derivatives of the two acids.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Easy Method of Preparing Condensed Hydrocarbides.—Watson Smith.—The author passes through an ignited tube vapours of naphthalin mixed with trichloride of antimony. Isodinaphthyl is obtained.

Addition-Products of Aldehyd.—M. R. Schiff.—This paper consists chiefly of hypothetical formulæ.

On Aniline-Black.—M. R. Nietzki.—The aniline used as material was prepared from crystallised benzol; it had a constant boiling-point (182°), and yielded no magenta when treated with chloride of mercury. The aniline-black was prepared by Müller's method:—A mixture of 20 grms. chlorate of potassa was heated with 30 grms. sulphate of copper, 16 grms. sal ammoniac, and 40 grms. hydrochlorate of aniline dissolved in 500 c.c. of water. Vapours escape, having the odour of chloropicrin, and the solution is converted into a greenish black paste. The vapours are not perceived when a salt of aniline is employed which has been purified by re-crystallisation, whence the author concludes that their origin is due to the presence of traces of nitrobenzol. The product of the reaction is boiled with dilute hydrochloric acid, dried, ground up, and treated with benzol, ether, petroleum, and alcohol; or it is preferably boiled with acidulated alcohol, which dissolves a large quantity of brown matter. There remains a dark green powder, which M. Reineck considers as the hydrochlorate of a base which he proposes to name nigranilin. Aniline-black dissolves in sulphuric acid with a violet colour, and is precipitated from this solution on the addition of water as a sulphate. Coquillion obtained aniline-black by the electrolysis of a salt of aniline, and R. Meyer by the action of permanganate of potassa. The author attempted to purify aniline-black by solution in concentrated sulphuric acid, but this method cannot be employed because the solution filters very slowly, and the product thus treated leaves on combustion a large quantity of ash. It is preferable to dissolve aniline-black in aniline, and then neutralise with hydrochloric acid, which throws down the colouring matter, but the yield is very trifling, as a large proportion remains in solution. The author concludes that aniline-black is the mono-acid hydrochlorate of a triamin, having the formula $C_8H_{15}N_3HCl$, and is composed of—

C	..	..	..	..	..	69.79
H	..	..	..	..	..	5.17
N	..	..	..	..	..	13.57
Cl	..	..	..	..	..	11.47

Constitution of Naphthalin.—M. F. Wreden.—This paper consists of hypothetical formulæ.

Titration and Assay of Salts of Soda.—M. A. Favre.

ing noxious species or as scavengers." In close proximity are shown the birds that are either injurious or beneficial. "The character of the birds is indicated in each case by the mark upon the perch or label; white indicating purely insectivorous birds, black those of wholly pernicious habits, and both colours the relative proportion of each element in these possessing more or less marked proclivities for a mixed diet. A little box in close juxtaposition to each affords the means of judging of these characteristics by an exhibit of the dried contents of a full stomach." Would not such a collection form a very useful feature in the economic museums of our country? The microscopic exhibits comprise highly magnified views of the fungi commonly known as "molds," so destructive to vegetation. The chemical department embraces an extensive assortment of rocks, with samples of the soils formed by their disintegration and decomposition of marls, mineral manures, such as phosphatic rocks and limestones, and of vegetable, animal, and compound manures. Another grand series shows useful agricultural and horticultural products and their preparations. Such collections are evidently of great permanent value and it is to be hoped will not be dispersed when the Centennial Exhibition is at an end. The Report for July contains notices of the steps taken in Spain for the destruction of locusts and for promoting the growth of forests. Locusts, it is found, like most other insect-plagues, are always most plentiful in dry, open, treeless wastes, land of the very class in which Spain is now so rich. There is an interesting article on the cultivation of coffee in Mexico and also in Brazil, and a variety of agricultural notices from many parts of the world. The Report for August and September is chiefly filled up with very complete returns of the condition of the principal crops throughout the United States. The agricultural interests of America are judiciously watched over by the Government, which, without any attempt at vexatious interference, collects and distributes valuable information, and what is equally important, puts it in a clearly intelligible form. It would certainly be beneficial to our agriculturists if monthly reports like the one before us were circulated amongst them. Forest-planting, strange as it may sound to those who conceive of America as it was a hundred years ago, is strongly and wisely advocated. The usual complaints about insect pests are not wanting. This evil is a necessary result of the system of gigantic fields without hedge-rows and trees, and consequently devoid of shelter for the small birds. Some interesting climatological facts deserve attention. Thus in Georgia the apples were mostly destroyed by a frost in April, although the district corresponds in latitude to the delta of the Nile.

MISCELLANEOUS.

County Analyst for Cheshire.—On Monday last Mr. J. Carter Bell, Public Analyst for Salford, was elected by a large majority to be the County Analyst for Cheshire.

The Monthly Reports of the Department of Agriculture.—The reports for May and June, 1876, issued from the Government Printing Office, Washington, contain a notice of the Centennial Exhibits of the Department of Agriculture. One feature of these, though nowise chemical in its nature, claims brief notice on account of its importance and novelty of arrangement. It is a collection of destructive insects, arranged, not according to their scientific classification, but according to the fruits, farm produce, &c., which they injure or destroy. "Thus under the head of 'potato,' the various insects known to injure the plant in root, stalk, leaf, or fruit are shown from egg to perfect insect, when practicable, accompanied with samples illustrating the mode of injury. Other cases illustrate the insect pests of man and cattle, the foes of the household, and the larder, whilst others show the principal insects beneficial to mankind either by destroy-

NOTES AND QUERIES.

* * Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Animal Charcoal.—Will any of your readers kindly refer me to a good work on the technical analysis of animal charcoal.—T. W. I.

Separation of Arsenic and Copper.—In answer to query concerning separation of arsenic and copper, I may say that I have experienced the same difficulty myself, and it is, I think, a very likely one for persons who have not practised long. I think it is from a fear of having too much alkaline sulphide in the solution that it arises. I may say too that I have found a little of either caustic soda or potash in the ammonium or other sulphide to be beneficial when copper and arsenic only have to be separated.—WM. ELLSTON.

Preservation of Iron from Action of Salt.—Can you give me the name and address of the society or English scientific academy which has offered a prize to the inventor of an agent which will actually preserve iron from the oxidizing action of the saline matter in the air of the Antilles, and especially from the action of salt-water, and which will at the same time prevent the aggregation of molluscs and shell-fish on the iron, wood, or stone which are plunged into such waters.—A.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 883.

ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 166).

87. With a large bulb, very well exhausted and containing a suspended bar of pith, a somewhat striking effect is produced when a lighted candle or other radiant source is brought about 2 inches from the globe. The pith bar commences to oscillate to and fro, the swing gradually increasing in amplitude until the dead centre is passed over, and then several complete revolutions are made. The torsion of the suspending fibre now offers resistance to the revolutions, and the index commences to turn in the opposite direction. This movement is kept up with great energy and regularity as long as the candle burns—producing, in fact, perpetual motion, provided only the radiation falling on the pith be perpetual.† If the candle is brought closer to the bulb, the rotation of the pith becomes more rapid; if it is moved further away the pith ceases to pass the dead centre, and at a still further distance the index sets equatorially. The explanation of the different movements of the pith index according to the distance the radiant body is off, is not difficult on the supposition that the movement is due to the direct impact of waves on the suspended body.

88. It is not at first sight obvious how ice, or a cold substance, can produce the opposite effect to heat, cold being simply negative heat (33). The law of exchanges, however, explains this perfectly. The pith index and the whole of the surrounding bodies are incessantly exchanging heat-rays; and under ordinary circumstances the income and expenditure of heat are in equilibrium. A piece of ice brought near one end of the index cuts off the influx of heat to it from that side, and therefore allows an excess of heat to fall upon it from the opposite side. Attraction by a cold body is therefore seen to be only repulsion by the radiation from the opposite side of the room.

Bearing the law of exchanges in mind, several apparent anomalies in the movements of these indices are cleared up; and it is also easy to foresee what the movement of a body will be when free to move in space under the influence of varying amounts of radiation.

The heat which all bodies radiate into space can have no influence in moving them, except there be something in the nature of a recoil in the act of emitting radiation. And even should there be such a recoil, if the body radiates heat equally all round, the recoil will be uniform, and will not move the body in one direction more than in another. I need therefore only consider the effect of the radiation received by a body. Here also the influx of radiation to a body free to move in space of a uniform temperature may be considered to be equal, and it will acquire the temperature of space without moving in any direction.

89. The case is, however, different if two bodies, each free to move, are near each other in space, and if they differ in temperature either from each other or from the limiting walls of the space. I will give here four typical cases, with experiments sufficient to prove the reasoning to be correct.

CASE I. Two hot bodies, A and B, in space of a lower temperature than themselves. The body A receives heat uniformly from space, except where the body B intervenes; and on this side A receives more heat, as B is hotter than the space behind it; A will therefore move from B. In the same manner it can be shown that B will move from A. The result will therefore be *mutual repulsion*.

FIG. 2. Case I.

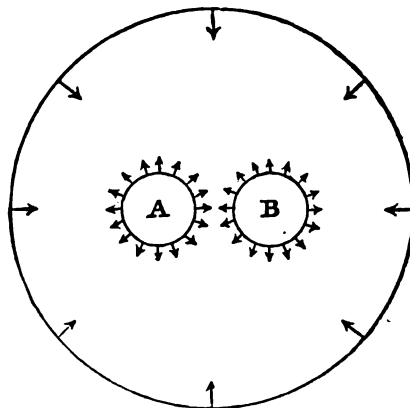
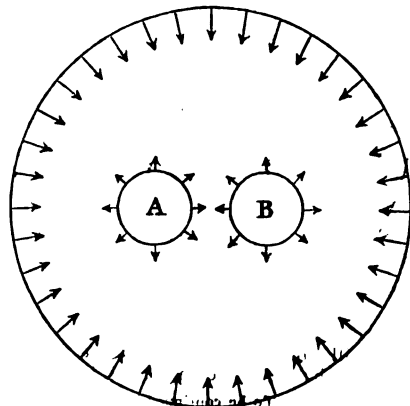


FIG. 2. Case II.



CASE II. Two cold bodies, A and B, in space of a higher temperature than themselves. A will receive much heat from space, except where B cuts it off, and on that side it will only receive slight radiation from B. A will therefore be driven towards B. In the same manner it can be shown that B will be driven towards A; and the result will therefore be an *apparent mutual attraction*.

CASE III. Two bodies, A hot and B cold, in cold space. The body A receives heat uniformly from all sides, even from that opposite B (B being of the same temperature as space). A will therefore not move. B receives heat uniformly from all sides, except from that opposite A, on which side the influx of heat is more intense. The result will therefore be that A *remains stationary whilst B is repelled*.

CASE IV. Two bodies, A hot and B cold, in hot space. The body A receives heat uniformly from all sides, except from that opposite B. Here the heat is less intense. A is therefore driven towards B by the extra influx of heat on the other side of A. B receives strong influx of heat from all sides, and just as much from the side opposite A as from any other. B will therefore not move. The result will be that A *will be apparently attracted towards B, whilst B will remain stationary*.

The force with which the bodies A and B in these four

* A Paper communicated to the Royal Society, March 20, 1875. From the *Philosophical Transactions of the Royal Society of London*, vol. clxv., pt. 2.

† This experiment was exhibited for the first time at the Royal Society's *Soirée*, April 22, 1874.

cases will be repelled, or apparently attracted, will vary with their distance from each other, being stronger when they are close and weaker when they are far apart. The

FIG. 2. Case III.

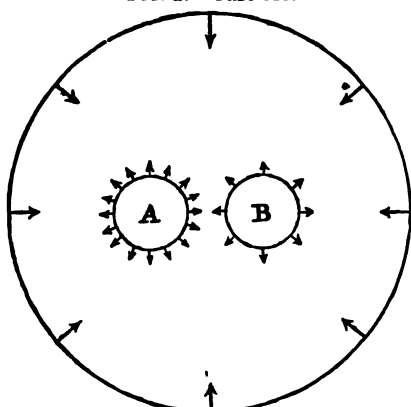
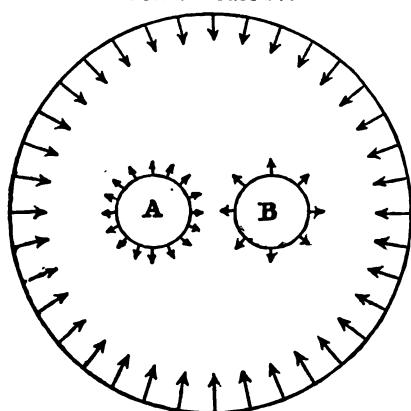


FIG. 2. Case IV.



diminution will not, however, follow the usual law of inverse squares, but a more complicated law.

To be continued.)

ON THE ACTION OF DIFFERENT FATTY OILS UPON METALLIC COPPER.*

By WILLIAM THOMSON, F.R.S.E., F.C.S.

WITH the view to study the actions of different fatty oils upon copper I made two series of experiments. In the first, which was commenced on the 1st October, 1875, I took twenty-six different samples and measured 150 grs. of each into bottles; into each bottle was then placed a piece of copper foil, 1 inch long by $\frac{1}{2}$ inch broad, so as to lie flat at the bottom of the oil. After a few days it was observed that some of the samples had acted on the pieces of copper, some had thrown on to the metallic surface a slight greenish incrustation, some had produced a dark coloured incrustation, and the remainder produced no effect on the bright metallic surface of the copper.

No special examination of either the metallic copper or the oils was made till they had remained in contact for ten months at the ordinary temperatures of the atmosphere.

The second series was commenced about one month later than the first, and differs from the first somewhat in the detail of its arrangement. Eighteen different samples were employed, each oil representing in both series a distinct and different sample, although in some cases two or more of the same kind of oil were employed, and I am indebted to the kindness of Mr. Wollaston, of Manchester, for the greater number of the samples used in both series and for the care which he exercised in obtaining samples which could be relied upon as being free from adulteration.

In this second series 300 grs. of each sample were placed in bottles, and a slip of well-cleaned metallic copper, $3\frac{1}{2}$ inches long by $\frac{1}{2}$ inch broad, put into each so that only one half of the slips was immersed in the oil, whilst the other half was exposed to the air.

The following is a list of the different samples used:—

IN FIRST SERIES.

Vegetable Oils.

1. Mesina olive oil.
2. Olive oil.
3. Rape oil.
4. Refined rape oil.
5. Cotton seed oil.
6. Pale cotton seed oil.
7. Cotton seed oil.
8. Linseed oil.
9. Almond oil.
10. Palm oil.

Animal Oils.

11. Lard oil.
12. Tallow oil.
13. Foreign neatsfoot oil.
14. Neatsfoot oil.

Fish Oils.

15. Sperm oil.
16. Pale seal oil.
17. Seal oil.
18. Common seal oil.
19. Whale oil.
20. Shark oil.
21. Cod oil.
22. Newfoundland cod oil.
23. Raw cod oil.
24. East India fish oil.

Mineral Oil.

25. Heavy mineral oil.
26. " "

IN SECOND SERIES.

Vegetable Oils.

1. Olive oil.
2. " "
3. Pale rape oil.
4. Brown rape oil.
5. Cotton seed oil.
6. Raw linseed oil.
7. Palm nut oil.
8. Ground nut oil.
9. Castor oil.

Animal Oils.

10. Pure lard oil.
11. Common tallow oil.
12. American tallow oil.
13. English neatsfoot oil.
14. North American neatsfoot oil.

Fish Oils.

15. American sperm oil.
16. Whale oil.
17. Pure seal oil.

Mineral Oil.

18. Lubricating mineral oil.

All these samples of oil, together with the slips of metallic copper left in contact with them, were examined on the 9th of August, 1876, in the following manner:—

First.—Each slip of copper was carefully examined and its appearance noted.

Second.—The appearance of each oil was observed and noted.

Third.—Ten grains of each sample were measured off by a pipette and placed in a small test-glass, and 5 grs. of a moderately strong solution of ferrocyanide of potassium added, and the oil and solution thoroughly mixed by stirring them together for some time and then leaving them for about a day. This method I found to give the most satisfactory result for testing the relative proportions of copper which had been dissolved by the oils; the characteristic brownish red precipitate of ferrocyanide of copper being thrown down admitted of very accurate comparison.

Fourth.—Fifteen grains of each oil were taken by means of a pipette, and each placed in a small stoppered test-tube; 15 grs. of distilled water were then added and each tube shaken violently. The tubes were then suspended in water and heated to about 200° F. and shaken violently two more times at intervals of one hour each, and allowed to remain in contact with the hot water at 200° F. for six hours; the source of heat was then removed and the oils allowed to remain over the night to allow the water to separate from the oils more completely.

* Read before the British Association, Glasgow Meeting (Section B.).

In the morning the water was drawn off from the tubes by a pipette having a long fine point, and each transferred to a small test-glass. A drop of each solution was then taken out by a clean glass stirring rod and spread across pieces of blue litmus paper in a series of lines side by side with each other, the intensity of redness thus produced by the acids dissolved by the water compared, and the results noted.

Fifth.—Five grains of a moderately strong solution of ferrocyanide of potassium were then added to each water solution above mentioned, the mixture stirred, and left for four hours, when the amounts of the precipitates of ferrocyanide of copper were observed comparatively and the results noted. The results of these observations I have arranged in tabular form.

(To be continued.)

PYROLOGY, OR ANALYSIS AND SYNTHESIS BY THE BLOWPIPE.

By MAJOR ROSS, late R.A.

(Continued from vol. xxxiii., p. 3.)

(11.) THE fact may have been noticed, with regard to the Scientific Loan Exhibition at South Kensington, that three-fourths of the apparatus, &c., there displayed are *foreign*, and that a great part of the remaining fourth, although the property of English "Manufacturers," has in reality been produced in Paris, Berlin, or some other French or German town, while Sir W. Thomson, Sir. J. Hawshaw, and others less celebrated, who have lately arrived from America, are unanimous in the opinion that, unless we are careful, the Americans will shortly pass us in those *manufactures* of which we have hitherto been most proud. In short, look on the matter as we may, deny the fact as we will, it seems doubtful if *nationally* England occupies more than the third place in scientific Europe.

(12.) The reason of this appears that, like everything else, scientific knowledge is made a mere matter of barter in England. Only rich men can here afford to do anything original in the way of physical or chemical experimentation.

(13.) Here then, briefly, is what the blowpipe will do for a student who takes it up with due appreciation:—

(a) The necessary apparatus is, or ought to be, *cheapest of the cheap*, even the balance required for quantitative analysis being the smallest and cheapest kind made. (b) Accurate observations can be made so *rapidly* that even the public teacher in chemistry and physics can thus most beneficially employ his little leisure. (c) The field of observation is almost entirely unoccupied, so that the disciple, unencumbered by the terrific terminology of chemistry, may after a short time bring contributions to physical science really worthy of her acceptance; while geology and mineralogy will after a time acquire a new zest from such examinations. (d) If our manufacturers were only equal to the Germans or French, a traveller's apparatus might be made for a few shillings, in a leather case, which would roll up and go into the breast pocket of a coat, enabling the investigator to start at a moment's notice for the country or abroad. I shall try to induce Messrs. Griffin to make up such a case of blowpipe necessities, and to sell it *as cheaply as possible*.

(14.) All sciences are so linked together that a correlation can be shown to exist even between two of the most apparently widely separated. Few, for instance, would suspect that the political economist could derive any benefit from the study of blowpipe analysis, and yet the case of the tumble-down barracks and public buildings all over Northern India, publicly stated, without denial, to have cost the Government £40,000,000, between the years 1861-75, is one in point; but the account of this must be reserved for the next paper.

ON ANTHRACEN TESTING.

By DR. FREDERICK VERSMANN.

In a paper "On Anthracen and Alizarin," read before the Society of Arts in March, 1874, I ventured to express my opinion that the quinon test was not trustworthy, because it did not represent true anthracen convertible into alizarin, and also because the stipulated correction, equal to 1 per cent, made the whole process illusory.

At that time I stood alone in my opinion, but it is now perfectly well known among manufacturers and buyers of anthracen that the quinon test does not always indicate the exact and true value of the merchandise; and even Messrs. Meister, Lucius, and Brünig, who first proposed the test, now acknowledge its inaccuracy by issuing in last week's *CHEMICAL NEWS* (vol. xxxiv., p. 167) a new and improved method.

This new test differs from the previous one merely by an increase of the oxidising agent—chromic acid and its solvent acetic acid and water—and by the treatment of the quinon with fuming sulphuric acid instead of with potassium permanganate, and subsequent volatilisation of the remaining quinon.

The publication of this "*new and improved method*" induces me to collect the results of prolonged investigations on the subject, which, although not yet brought to a final conclusion, may tend to throw some light on the nature of the products obtained, and I am the more inclined now to publish my experience, because more than six months ago I tried the sulphuric acid myself, but found it neither satisfactory nor practical. In fact it was exactly the failure with sulphuric acid which induced me to follow up the subject in a different direction, and, as I believe, with more satisfactory results.

After boiling a sample of anthracen with chromic acid solution, and allowing the mixture to stand for hours, long, well-defined crystals separate, and on adding water a further separation takes place, not in the form of crystals, but of an amorphous powder. The product collected on the filter is always a mixture of crystals and powder, part of the last of which is again removed by potassium permanganate and potassium hydrate.

This observation induced me to collect the crystals and powder separately, and to ascertain their nature by practical tests applicable for commercial analyses. As such I adopted, above all, the melting- and solidifying-points, and then the action of potassium permanganate and potassium hydrate.

The determination of the melting- and solidifying-point I look upon as most important and valuable, and I can only express my surprise that it has not been introduced long ago, especially as it formed so important a part in the alcohol and bisulphide test.

I have collected in the following table some results from a great many, which fairly represent commercial anthracen from the lowest to the highest percentage. The first column gives the percentage of quinon actually obtained, i.e., without correction; the second and third columns give the crystals and powder separately; and the last column the number of drops of 5 per cent potassium permanganate solution required to leave a distinct colouration after prolonged boiling of each of the three products.

As to the operation itself, the first result was obtained by the usual test with appendix. In the separation of crystals and powder the solution was allowed to stand over night; the crystals were then collected on a small filter, and the solution allowed to run off to the last drop, before the crystals were washed with water, until the filter and filtrate were perfectly colourless. The filtrate was then diluted to 600 c.c., and after two hours' standing the powdery precipitate was also collected on a filter; both crystals and powder were then treated with potassium permanganate and potassium hydrate.

I have long adopted an increased addition of water, but for a different reason than the one now stated by Messrs.

Anthraquinon Test.

	Crystals and Powder Mixed.	Crystals.	Powder.	Drops of 5 p.c. Potassium Permanganate.
	283	278		
1. 11'4	275—279	6'6 272—275	4'8 not at 300	15 3 20
	280	278	274	
2. 11'9	274—277	9'4 274—276	2'7 264—269	10 3 12
	277	278	275	
3. 14'2	273—275	10'2 272—275	4'0 273—274	6 2 5
	278	279	270	
4. 14'2	270—274	9'2 273—276	5'3 272—271	10 4 16
	278	278	273	
5. 15'2	270—274	10'3 272—275	5'4 271—272	9 4 10
	276	278	280	
6. 15'2	274—275	10'2 274—276	4'6 270—275	8 3 10
	276	278		
7. 16'0	270—273	12'5 274—276	3'6 not at 300	25 3 28
	278	277	278	
8. 16'2	274—276	11'6 273—275	5'2 266—272	12 4 12
	270	277		
9. 17'8	266—268	9'8 273—275	7'7 not at 300	27 4 27
	279	277		
10. 18'2	271—275	14'2 275—276	3'9 not at 300	20 4 24
	278	277		
11. 20'2	274—276	16'3 273—275	3'7 not at 300	9 3 10
	277	277		
12. 20'6	273—275	17'8 275—276	2'6 not at 300	15 4 14
	277	281	276	
13. 22'0	273—275	18'3 273—277	4'0 266—271	16 5 15
	270	276	260	
14. 23'3	266—268	15'1 272—274	8'0 256—258	6 2 6
	278	278	278	
15. 23'8	274—276	19'9 276—277	3'6 270—274	8 2 7
	280	280	271	
16. 26'4	274—277	22'1 276—278	4'2 261—266	10 3 11
	277	278	270	
17. 27'0	273—275	20'8 274—276	6'1 260—265	12 2 14
	270	274	264	
18. 30'2	268—269	24'9 274—274	5'3 256—260	8 3 10
	273	277	259	
19. 30'5	267—270	24'6 273—275	5'6 253—256	10 4 14
	278	278		
20. 34'8	268—273	30'0 276—277	4'6 not at 300	22 6 20
	280	280		
21. 36'5	274—277	30'6 274—277	5'7 not at 300	16 5 18
	280	281		
22. 37'2	274—277	33'1 277—279	4'0 not at 300	12 5 16
	271	275	262	
23. 39'9	267—269	34'0 273—274	5'8 258—260	8 2 8
	278	278	276	
24. 41'7	276—277	38'3 276—277	3'3 264—270	10 3 12
	278	276	270	
25. 45'2	270—274	41'1 274—275	4'0 266—267	9 3 10
	268	275	246	
26. 49'5	268—268	40'9 271—273	8'7 250—248	10 2 10
	280	280		
27. 52'5	272—276	47'9 274—277	4'7 not at 300	16 4 16
	279	280		
28. 56'3	275—277	53'9 274—277	2'6 not at 300	16 3 16
	280	275	250	
29. 60'0	270—275	55'4 273—274	4'2 240—245	12 2 14
	282	280	285	
30. 68'5	272—277	63'2 276—278	5'1 287—286	10 3 12

Meister, Lucius, and Brüning. I have always doubted the accuracy of adding 1 per cent of quinon, supposed to be retained in solution, and I have satisfied myself on that point by actual experiment. I have frequently evaporated the green solution to perfect dryness, and exhausted the dry powder with benzol and alcohol, but I have never succeeded in separating real quinon. The larger quantity of water merely separates the powder more completely, which no doubt accounts for the increased quantity of potassium permanganate used with the powder.

The conclusions drawn from this table, I may state as follows, viz. :—

1. The total of crystals and powder in all cases very nearly agrees with that of the mixture; no loss is incurred by the separation.
2. The melting- and solidifying-point of the mixture, i.e., of the usual test, is mostly suspicious, in many cases a direct indication of undoubted impurity of the quinon.
3. The melting- and solidifying-points of the crystals alone are much more uniform; the product is pure quinon.
4. The powder in almost all cases is no quinon at all; in eleven cases out of thirty it does not melt at 300° C., but blackens and remains solid; in eleven other cases the mean of the two points is below 270° C., and in several of the other cases the melting- and solidifying-points were only partial or indistinct at the points indicated.
5. The effect of potassium permanganate is uniformly very trifling upon the crystals, very considerable upon the powder, and exactly the same is the case with potassium hydrate; while the mixture often imparts distinct colouration to the solution and becomes itself lighter in colour—from orange to pale straw-yellow—the crystals alone scarcely show any change, but the powder invariably gives a strong colour to the solution.
6. While the crystals may safely be taken as pure quinon, the question arises whether the powder always consists of nothing but impurities, or whether it still retains some quinon, as in a few cases the melting-point tends to indicate.

Although I have not completed my experiments in that direction, I shall shortly be able to definitely settle this point by practical tests.

But I think it advisable not to delay the publication of my results hitherto obtained, as I am satisfied of the correctness of separating crystals and powder and of its undoubted advantage over the other known test.

I have meanwhile brought my test into practical working by taking the crystals as pure quinon, and by considering the powder as valueless impurity in all cases where the melting- and solidifying-point is below 270° or above 280°, and by adding the powder to the crystals as quinon whenever these two points range between 270° and 280°.

This compromise, for such I admit it to be at the best, has given general satisfaction to those who had it tried; and although I hope in a short time to complete my investigation, I meanwhile propose the above test, which, briefly stated is as follows :—

Boil 1 gm. of the sample for four hours with 15 grms. of chromic acid dissolved in 10 c.c. of glacial acetic acid and 10 c.c. of water; allow it to stand for twelve hours, collect the crystals on a small filter, and let the solution run off to the last drop; then wash the crystals with boiling water till the filter and filtrate are quite colourless, dilute the filtrate with water to 600 c.c., let stand for two hours, and collect the powdery precipitate on a filter and wash well. Then treat both crystals and powder—separately, of course—with potassium permanganate and potassium hydrate as hitherto, collect each on a double filter, dry and weigh, but do not add the correction; then take the melting- and solidifying-point of both. The

crystals to be taken as pure quinon, the powder also to be taken as quinon if melting- and solidifying-points range between 270° and 280° , but as valueless impurities if these two points are below 270° or above 280° .

This test is more reliable, and more just to buyer and seller, than either the usual quinon test or the one now proposed by Messrs. Meister, Lucius, and Brünig.

My experience as to the action of sulphuric acid upon crude quinon is as follows.

(To be continued.)

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

No. V.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(Continued from p. 169.)

(3.) *On the Chemical Character of the Pigment of the Negro Skin.* By Dr. F. P. FLOYD, of Tazewell Co., Virginia.

It is natural to suppose that the substance which gives the characteristic black colour to the skin of the negro is probably modified blood pigment, as is pretty generally assumed to be the case in reference to the "melanin" of the choroid coat of the eye; but this point does not seem to have been made until now the subject of experiment. I suggested to Dr. Floyd to examine qualitatively the character of the pigment in question, and to get, if possible, some approach to a determination of the amount of iron in the ash as the means of testing the probability of a connection with hæmatin.

Strips of cuticle with a little of the outer layer of true skin attached were taken from a negro cadaver, and having been well washed with water and alcohol, and with ether to remove fatty matter, were cautiously scraped with the blunt edge of a scalpel, in order, if possible, to loosen up the pigment granules and permit of their separation and purification by mechanical washing. A very little examination with the microscope, however, showed that this could not be done without breaking up the whole substance of the cuticular tissue, and mixing its debris with the granules, which therefore could not be obtained in a state of purity. By selecting only those parts in which there was most pigment, and cautiously treating these as above, enough of it was procured with but little admixture to establish the following points. The colouring matter is insoluble in water, alcohol, and ether. It is also undissolved by treatment with dilute acid or alkaline solutions. It is but slowly attacked by the strong acids, even by concentrated nitric acid. Chlorine, especially in the presence of alkalis, completely destroys it. Heated for some time with a strong solution of sodium hydrate it is gradually dissolved, and the solution when diluted yields a partial precipitate on neutralisation with an acid. In all these respects the behaviour of this substance agrees perfectly with the melanin of the eye.

In order to get an approximation to the quantity of iron present, as the pure pigment could not be had, comparative experiments were made with the cuticle of black and white subjects with the following results:—

No. 1.—*Skin from the outside of the upper arm of a Negro man, aged about 50 years, born in United States.*—The cuticle and a little of the outer portion of the cutis were taken, washed with water and alcohol, macerated in ether for twenty-four hours to remove fat, and then dried at 100° C. 21.249 grms. of the dry material on being carefully and completely burned left 0.424 grm. of ash

= 2.0 per cent. This ash was dissolved in a very small quantity of sulphuric acid, the solution diluted, and the iron (easily diluted in previous quantitative experiments) reduced to a ferrous salt by a minimum of pure zinc, determined by a much diluted solution of potassium permanganate. The result was 0.00859 grm. of Fe = 2.02 per cent of the ash.

No. 2.—*Skin from the outside of the thigh of a Negro woman, aged about 40 years, born in Virginia.*—The cuticle was rather more completely separated from the true skin than in the last instance. The same treatment was applied. 2 grms. of material dried at 100° C. left 0.056 grm. of ash = 2.8 per cent, and in this there was present 0.00142 grm. of Fe = 2.54 per cent of ash.

These specimen of negro skin were obtained from the Anatomical department of the University of Virginia; for those from white subjects, which at the time were not available here, we were indebted to my friend Dr. Souchon, of New Orleans.

No. 3.—*Skin from the anterior surface of the thigh of a white man, 40 years of age, born in Maine.*—The epidermis was taken off pretty clearly, with very little of the true skin remaining attached to it. Same chemical treatment as above. 18 grms. of the dry cuticle gave 0.207 grm. of ash = 1.15 per cent, in which was found Fe = 0.00235 grm. = 1.13 per cent of the ash.

No. 4.—*Skin from anterior surface of upper portion of thigh of a white man, aged 45, born in France.*—Cuticle taken off as clearly as possible and treated as before. 15.354 grms. of dry skin gave 0.175 grm. of ash = 1.14 per cent, yielding 0.00226 grm. of Fe = 1.29 per cent of the ash.

It appears from the mean of these results that the negro cuticle leaves on being burned double as much ash as that of the white man (2.40 per cent against 1.15), and that the difference is nearly as great in the percentage of iron in the ash (2.28 against 1.21), thus rendering the presence of a considerable amount of iron in the black pigment highly probable, and increasing the likelihood of this being a product of the alteration of the colouring matter of the blood.

As regards the local distribution of the pigment granules there seems to have been hitherto a little confusion of statement. In the older books they are said to occur in the "rete mucosum" between the epidermis and cutis, and, although the existence of such a distinct middle layer of the skin is no longer admitted and the name for it has therefore disappeared, the same general idea seems to remain that the colouring matter belongs to the sub-cuticular portion of the skin, and hence impliedly that it does not extend outwards into the cuticle itself. I have found too in the Southern States many physicians under the impression that a blister produced upon the negro skin is white, or at any rate much lighter in colour than the surrounding surface. From the chemical inalterability of the pigment, as above ascertained, this would seem very unlikely; a few observations were therefore made upon the subject.

Thin vertical sections of negro skin from the cadaver were made, and these under the microscope showed brown and black granules to the very edge of the cuticular surface, which, however, seemed to have been partially removed, probably by post mortem softening and the washing which the subject had received.

A few extremely thin horizontal shavings were therefore taken off with a razor-like scalpel from the arms of two living negroes, man and woman respectively, drawing no blood and cutting with the blade so slanted as to thin off one side of the shaving to nothing. These sections showed under the microscope the pigment granules through the whole of the cuticle, though less easily observed among the epidermic scales than in the less dense structure beneath in which the flattening of the cells had not yet gone so far. Finally, one or two small blisters were produced by very small drops of a solution of cantharidine, and the raised cuticle from these gave quite the

same result under the microscope. The blisters themselves before being punctured were distinctly brown to the naked eye, while no doubt the side light which comes in through the projecting mass of transparent colourless fluid has a tendency to produce the impression of lighter colour upon the observer.

There can be no doubt, I think, that the brown or black pigment originates in the outer layer of true skin, its production being probably connected with the loss of vitality of the cells, and that it accompanies these cells all the way to the surface, where it is mechanically removed by disquamation. The chemical modification of the red colouring matter of the blood corpuscles may possibly be in some way dependent on feebleness of circulation in the superficial capillaries, to which would seem to point a number of facts as to the diseases to which negroes are specially liable, as well as their extreme sensitiveness to low atmospheric temperature, a severe frost which would be little more than bracing to a white man often fairly benumbing all their faculties, bodily and mental.

(4.) *Analysis of Cinnabar from Oregon.* By C. W. DABNEY, Jun., of Hampden Sidney College, Virginia.

A specimen of cinnabar in calcite from the land of Dr. F. C. Horsley, near Canyon City, Oregon, when pulverised and treated with dilute hydrochloric acid, gave off sulphuretted hydrogen. This fact seemed to make it worth while to analyse the specimen carefully, and it was placed in Mr. Dabney's hands for the purpose. It was found that after being thus treated with acid it gave, on heating in a closed tube, a small sublimate of sulphur, and the residue on being again treated with hydrochloric acid gave an additional amount of sulphuretted hydrogen, whilst iron was found in solution.

A specimen freed from the calcite gangue by very weak acetic acid was dried, weighed, and acted on with hydrochloric acid of 6 per cent real acid. The sulphuretted hydrogen given off was collected as sulphide of silver, and its amount determined. The residue was then analysed by ordinary methods, adding in the small quantity of iron which the hydrochloric acid had taken up. The results were:—

Mercury..	.. .. .	78.42
Sulphur	{ given off as H ₂ S	0.54
	{ in residue	13.59
Iron ..	.. .. .	4.09
Silica ..	.. .. .	3.06
Oxygen (by difference)	.. .. .	0.30

100.00

From the behaviour of the mineral with hydrochloric acid and on heating it may fairly be concluded that part of the iron exists as ordinary iron pyrites and part as magnetic pyrites. If now the sulphur be distributed, first, to mercury to form HgS; second, to the extent of that evolved as H₂S, to iron to form magnetic pyrites (assuming this to be Fe₇S₈); and, third, the residue, to iron enough to form iron pyrites, the rest of the iron being assumed present (as some visibly was) as ferric oxide; the above analysis will stand thus:—

HgS ..	.. .. .	90.97
Fe ₇ S ₈ ..	.. .. .	1.37
FeS ₂ ..	.. .. .	1.95
Fe ₂ O ₃ ..	.. .. .	3.36
SiO ₂ ..	.. .. .	3.06

100.71

These results may serve to explain, at least in some cases, the abnormal proportions of sulphur and mercury in the published analyses of cinnabar, the iron having hitherto always been reported present as ferric oxide, and no other mode of combination suggested for the sulphur, which is almost always in excess. Thus in the analyses given by Dana and Rammelsberg, neglecting other constituents—

No.	Locality.	Analyst.	For 200 parts Hg we have of S.
1.	Neumarktel	Klaproth	33.52
2.	Japan	"	34.90
3.	"	John	44.64
4.	Westphalia	Schnabel	31.50
5.	Wetzlar	"	44.42
6.	California	Bealey	32.82
7.	Idria (hepatic)	Klaproth	33.62

instead of 32.0, as demanded by theory. In the third and fifth of these analyses native sulphur was probably present.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 167.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

We may here also mention the bromiferous artificial saline mixtures prepared in imitation of the salts obtained from mineral springs.† At Vienna the mother-liquors and their salts of Kreuznach, Koesen, Wittekind, &c., were exhibited by Frank, and by the United Manufactures of Leopoldshall. Finally, we must mention the arrangements adopted for preserving the workmen from the injurious action of bromine. It appears, in fact, that when these are applied no danger to health is to be apprehended. In the selection of workmen it is primarily essential to see that they have well-developed respiratory organs, and are free from any predisposition to asthma and catarrhal affections. The use of spirituous liquors must be strictly interdicted, as the irritability of the mucous membranes which they produce is exceedingly dangerous. On the other hand, a generous diet is recommended, and especially the abundant use of fatty and mucilaginous articles, butter, bacon, &c.

As it appears that the workmen do not make use of the respirators with which they are furnished, and at most merely tie a cloth over the mouth and nose when decanting large quantities of bromine, the most important point is to secure an efficient ventilation in all parts of the works. By attention in this respect, combined with the above-mentioned dietetic regulations, it has been found practicable to maintain the health of the workmen at Stassfurt, during the eight years of the existence of the bromine manufacture, so long as they refrain from the use of spirituous liquors (Frank).

(The editor of this Report has had opportunity during a recent excursion to Stassfurt to visit Frank's bromine works, and, it may be, permitted him to add certain results from his own observation in order to complete what has above been given in bold outline.)

The distillation of bromiferous mother-liquors with manganese and sulphuric acid is conducted in large cubic stone vessels made in one piece, and belted with iron bands in case of a fracture. Their average capacity is 3 cubic metres. At some distance from the bottom is a perforated plate of the same kind of stone, upon which the manganese is placed in fragments of the size of a nut. The stone trough is covered with a heavy plate of the same material, which is raised and lowered by means of a rope with a counterpoise playing over a pulley. In this cover there is introduced a thick stoneware pipe for the introduction of steam; and it is also provided with a man-hole,

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† In Germany such saline mixtures are used under the name of "bath salts" (*bade-salze*).

an aperture for pouring in the bromiferous liquid and the dilute sulphuric acid, and an opening for the escape of the bromine vapours.

Few stones are suitable for the construction of these vessels, and when the bromine manufacture was introduced at Stassfurt there was great difficulty in finding a suitable quality. Almost all the stones tried experimentally after a time allowed the chloride of manganese to ooze through, and required to be coated with tar to overcome this defect. This, however, gave rise to a new inconvenience, considerable quantities of bromine being lost by the conversion of the hydrocarbons of the tar into bromine compounds, and the bromine itself becoming contaminated. Dr. Frank estimates the loss for every new coating of tar at about 50 kilos. of bromine. Latterly a kind of stone has been found in the neighbourhood of Porta Westphalica which does not require this costly preparation and can be used at once. Still the high price of these stone troughs has given rise to attempts to manufacture bromine stills with large plates of slate, cramped together with iron bands and screws. A final decision has not yet been obtained.

(To be continued).

NOTICES OF BOOKS.

How to Avoid Typhoid Fever and Allied Diseases. By ARTHUR H. DOWNES, M.B., M.D. London: Baillière, Tindall, and Co.

THIS pamphlet gives plain and useful directions how to prevent the introduction of sewage-gases into dwellings. The dangers of allowing water-closets to be supplied from the same cistern which furnishes water for the culinary purposes of a household is clearly shown; so also are the shortcomings of the ordinary drain-traps, and of sinks which lead direct into the sewer. The author urges that water-closets should always be built projecting from the house, and be provided with a kind of ante-chamber fitted with a window on each side, so that the closet itself may not be ventilated into the house. Such arrangements are certainly very desirable, but unfortunately they are beyond the reach of the many. In some towns the closets are placed in the interior of the houses, without any window or any other direct communication with the open air. But even this is not the worst. We once observed clouds of steam issuing from the closet in a certain hotel where our evil star had led us to take up our quarters, and we fear that there must have been some connection with the hot-water cistern in the kitchen.

Dr. Downes denounces the vile practice of placing the foundations of houses upon "made ground,"—i.e., accumulations of putrescent rubbish. For this offence an appropriate legal enactment, with penalties heavy enough to penetrate to the conscience of the wealthiest contractor, is sorely needed. Not less do we require a stringent measure prohibiting the passage of drains beneath the flooring of houses, a mal-practice against which a large number of medical health-officers have formally protested.

Dr. Downes gives instances where the excreta of a patient suffering from typhoid fever having been thrown upon a dunghill, communicated the disease afterwards to men employed in carting the heap away. It is exceedingly probable, therefore, that fields irrigated with sewage containing fever "germs" will communicate the disease to persons employed in their cultivation. The author indeed remarks, in a foot-note,—"There is no evidence to show that even when a cow has been fed upon sewage-manured grass the milk acquires any infectious property *per se*." But there is evidence to show that the juices of sewage-grass differ in their properties and behaviour from those of natural grass, and that the milk of cows fed upon sewage grass enters into putrefaction much more rapidly than that of cows placed upon ordinary diet.

In speaking of epidemics of typhoid fever the author states—"In the case of the Marylebone epidemic, in 1873, the cause was traced to the milk from a certain farm far away in the country. The farmer had died of typhoid, and his excreta had contaminated a certain well, with the water from which the milk-cans were washed." We really were of opinion that this alleged Marylebone epidemic had been consigned to the realms of mythology. There is scarcely a sound link in the chain of evidence which was produced on the occasion. The deaths from typhoid in the district, at the time given, were below the average. The farmer was certified as having died of a disease of the heart. The water of the accused well was used for domestic purposes by several people in the village, none of whom were attacked with enteric fever.

A regular inspection of dairies, as Dr. Downes recommends, would be an exceedingly difficult thing to carry out in practice, and would assuredly be avenged upon consumers in the shape of a fearful rise in the price of milk and butter.

Upon the whole we must say that this little work deserves a wide circulation, and is calculated to effect much good.

*Vegetable Fibre, and its Preparation for Industrial Uses**
By Dr. HUGO MÜLLER (of London). Brunswick: F. Vieweg.

THIS valuable work is a reprint from the official report of the Vienna Exhibition of 1873. The author sets out with an account of cellulose, the formation of wood and cork, textile vegetable tissue, the nature of the bleaching process, the distinctive characteristics of the different vegetable fibres, the quantitative determination of cellulose, and the hygroscopic nature of vegetable fibre. On the latter very important subject the author gives a table, from which we learn that Belgian flax in its air-dried condition contains 5.70 per cent of water, cotton 6.66, and Manila hemp as much as 12.5. In air saturated with aqueous vapour the amounts taken up are much greater. Thus cotton absorbs 20.99 per cent, and Manila hemp 40. These figures have not merely a commercial importance for the purchaser of fibrous materials, but they are even more interesting as regards public health. Substances which when supposed to be dry may contain 6 per cent of water must certainly have a deleterious effect when worn next to the skin. An astonishing number of coughs and rheumatic attacks, and in tropical climates of more acute diseases, are due to the linen and cotton under-clothing still worn by so many.

On the recognition of the different vegetable fibres Dr. Müller very justly remarks that this end cannot, as a rule, be effected by chemical means, since the essential substance present, cellulose, must when pure give always the same reaction. Only in exceptional cases certain raw fibres give characteristic coloured reactions due to their less important constituents. Thus *Phormium tenax*, New Zealand hemp, gives a red coloration with nitric acid, and jute and its allies a yellow colour with the sulphate of aniline; but when the fibres have been bleached these distinguishing reactions no longer appear. The microscopic characteristics are more widely available. As has been shown by the researches of Wiesner, almost all vegetable fibres under the microscope display features by which they may be recognised. In addition to the generally constant length, breadth, and thickness of the membrane of the cells which constitute any given fibre, there are commonly detected other histological elements and crystalline mineral inter-deposits, which together form a basis for methodical examination. The application of certain micro-chemical reagents—such as ammoniuret of copper, sulphuric acid and iodine, sulphate of aniline, &c.—is of great value. Still the detection of a manufactured fibre remains a task which requires no little skill and experience.

* "Die Pflanzenfaser und ihre Aufbereitung für die Technik."

For the quantitative determination of cellulose Dr. Müller proceeds as follows:—Two grms. of the material in question are dried at 110° to 115° . If resins, wax, &c., are present, they are extracted with a mixture of strong alcohol and benzol, and the mass is then repeatedly boiled with water or very dilute ammonia. The residue is then bruised in a mortar with a pestle of box-wood. In operating on woods fine plane-shavings are the most convenient form, and require no further preparation. The mass is now placed in a large wide-mouthed stoppered glass, with 100 c.c. of water. A solution of bromine, containing 2 c.c. of bromine to 500 c.c. of water, is then added, to the extent of 5 or 10 c.c., according to the nature of the material. When the yellow colour of the liquid disappears a fresh portion of the bromine solution is added, and so on until free bromine may be recognised in the liquid, even after standing from twelve to twenty-four hours. The mass is now filtered, washed with water, and heated nearly to a boil, with about 500 c.c. of water to which 2 c.c. of ammonia have been added. The mass is filtered, washed with water, returned to the stoppered glass, and again treated with water and solution of bromine, as before. This alternating treatment with ammonia and bromine is thus repeated three or four times, and finally—on washing with water, and then with boiling alcohol—pure cellulose is obtained as a mass, dazzling in its whiteness. It may be considered pure if—after remaining for twenty-four hours in contact with very dilute solution of bromine, and subsequent treatment with warm dilute ammonia—no coloration appears in the liquid.

The author is of opinion that the determination of cellulose will become of practical importance in the future, as new fibrous materials will doubtless be introduced into the market, and as it will become necessary to ascertain the result of the various processes for their preparation.

The remaining and larger portion of the work is devoted to an elaborate description of the vegetable fibres already in use, and of those capable of industrial application, the number of which will surprise those who have not examined this subject. Particular attention is given to a survey of materials suitable for the paper-trade, and to an account of the improved processes, mechanical and chemical, for its preparation.

We must strongly recommend Dr. Müller's work to all who take an interest in vegetable fibres and their applications, and especially to all concerned in textile manufactures, in the paper-trade, and in the development of the resources of our colonies.

CORRESPONDENCE.

REPORT OF STATE BOARD OF HEALTH OF MASSACHUSETTS.

To the Editor of the Chemical News.

My attention has recently been called to your issue of July 28, in which I find a review of the last report of the State Board of Health of Massachusetts; I rely on your candour and courtesy to give equal prominence to my reply.

First, as regards Leeds, my statements are, in the main, corroborated by the prospectus of "The Clarifying and Utilisation of Sewage Company" (acknowledging by their very name that they do not assume to purify the sewage), by authorities whom I have quoted, and by articles in the *Leeds Mercury* and the *Yorkshire Post*, of December 23, 1874, although I may have misunderstood my informant, who was an intelligent man, familiar with the details of the work, as to some unimportant matters. I do not know how the error occurred by which I made the number of tanks six instead of twelve, unless by mistake in copying or proof-reading, which I failed to detect; it does not appear in my notes. You say—"The author admits the

absence of offensive smell. Here he contradicts one of the most preposterous assertions of the Rivers' Pollution Commission, that 'bad smells are always perceptible.' " My statement is—"There is no offensive smell . . . except from the moist precipitate" (p. 349).

As to Leamington, I find my notes confirmed by the *London Standard* of October 17, 1874, and by the *London Times* of October 21, 1875. I am sure that the authorities will not say that my expression of "costly and expensive failures," as applied to their experience with the precipitating processes, is at all too strong.

You say—"No mention is made of the important results obtained by Mr. Smee, jun., who showed that milk and butter obtained from cows fed on sewage grass became more rapidly offensive than that of cows fed upon normal herbage. No notice is taken of the important evidence of Mr. Markham that irrigation, even with common river water, and applied only when necessitated by dry weather, injures the health of the surrounding districts in India. No less has Dr. Folsom left out of account the valuable report of M. Lefeldt, the Prussian Commissioner, who complains of the 'mephitic odours' on the model sewage farm, and who found the stems of grass from irrigated meadows full of unassimilated sewage matters."

I have given more than a page to the consideration of Mr. Smee's statement (pp. 344 and 345). I have distinctly stated the fact well known to Mr. Markham and others with regard to irrigation in India (p. 335). The "mephitic odours" found by Lefeldt on "the model sewage farm" (Breton's Farm) were due, as he says on page 6 of his Report, lines 24, 25, 26, not to the process of irrigation, but to the precipitating tanks, which he and I both condemned. His other statement, with reference to the Craigentenny Meadows, is that "when the rye-grass is irrigated within two days of the time of cutting a rank growth was produced which cattle do not eat, and which was full of unassimilated sewage for a few inches above the roots." This fact he did not consider of sufficient importance (being due to bad management) to mention at all in his general *résumé*. Finally, Lefeldt says that sewage distribution, if properly managed, does not create more stink than is ordinary on farms (pp. 13 and 54), and (p. 48) that there was a horrible smell (*Ein entsetzlicher Geruch war damit verbunden*) from the drying of the precipitate in the A B C process, even when special care was taken at the time of his pre-arranged visit with the chief engineer.

As to England, I have given my authorities, and there I am content to let the matter rest.—I am, &c.,

CHAS. F. FOLSOM.

Boston, September 1, 1876.

[In inserting Dr. Folsom's letter we cannot see that he has in any way substantiated those statements upon sewage precipitation which we denounced as grossly inaccurate. As regards Leeds, surely the name which a local company has thought fit to assume, even if backed by random newspaper articles, is a curiously feeble argument to set against the official reports and certificates of the responsible authorities, the analyses of a chemist like the late Dr. Letheby, and the observations of scientific men made during prolonged and reiterated visits of inspection! The informants who misled Dr. Folsom into speaking of six tanks of iron in place of twelve of stone may well be deemed inaccurate in matters less obvious, and may possibly have evolved the odour of the mud out of the depths of their own consciousness. Dr. Folsom's statement that "there is no offensive smell except from the moist precipitate" does not agree with the declaration of the Rivers' Pollution Commissioners that "bad smells are always perceptible;" so that we cannot withdraw the compliment which we offered him. As concerns Leamington, whatever canards may have found their way into the papers, our statement is an indisputable truth. When we read the next paragraphs of Dr. Folsom's letter we began to fear that we had inadvertently made an unfounded accusation. But we turned to "page 335," and

found no mention whatever of Mr. Markham or of his report, not a word to prove that Dr. Folsom was aware even of his existence! We turned next to "pages 344 and 345," and found matters very little better. Three lines are given to a notice of Mr. Smee's letter to the *Times* in 1873, but the more recent work of Mr. Smee, jun., to which we referred, is not noticed. The remainder of the "more than a page" consists of "opinions" and negative evidence, of very little value when opposed to actual experiments. As regards the "mephitic odour" on Breton's Farm, Dr. Folsom's attempt to explain it away is ingenious, but cannot be admitted for a moment. The settling-pits (not precipitation-pits, which would imply the use of a precipitant) were part and parcel of a system of irrigation. If abolished, the solid impurities which they were intended to retain would be scattered over the whole farm, and would produce a nuisance less concentrated but more general. If unassimilated fecal matters can penetrate into living vegetable organisms at all, who dares to fix the time required to render them harmless? If there is anything wrong on a sewage farm it is always ascribed to "bad management." But if there is the slightest nuisance at any precipitation works it is charged as a fundamental error to all sewage processes. To M. Lefeldt's allegation, that an evil odour arises from precipitation-manure on drying, we may oppose the testimony of Mr. Keates, an authority no less eminent than impartial. We will merely add that Dr. Folsom's remarks on Leeds and Leamington could be refuted, if necessary, both by official documents and oral testimony sufficient to satisfy any court of justice.—*Ed. C.N.*

THE PINK LIQUORS OF THE CHLORATE OF POTASH MANUFACTURE.

To the Editor of the Chemical News.

SIR,—It has often been said that the rose-red colour which appears upon the complete saturation of the lime with chlorine in the manufacture of chlorate of potash also appears in the absence of manganese, and as it is well known that this colour is due to permanganic acid, I was not a little surprised to find Dr. Mylius (*CHEMICAL NEWS*, vol. xxxiv., p. 139) giving even slight credence to the statement that this colouration could appear "in the absence of manganese." In the same paragraph it is also stated that the rose-red colour is also obtained in the absence of manganese at Messrs. Kunheim's works at Berlin, where Deacon's process is used for the preparation of the chlorate, leading one to suppose that the colouring matter was other than permanganic acid in this case.

In *Dingl. Polyt. Journ.*, ccxv., p. 237, Opl states that an unfiltered chloride of lime solution becomes rose-coloured on boiling by the formation of ferric acid from the ferric oxide of the calcium hydrate employed. Now, from experiments made at intervals during the last five years, I find that the colour is *always* due to permanganic acid, and that the manganese is not carried over mechanically with the chlorine; but the permanganic acid is formed by the continued action of the chlorine upon the manganese compounds contained in the lime used in the process.

I have examined many samples of lime, limestone, and chalk, but have not met with one yet absolutely free from manganese; and, furthermore, all the pink liquors from the chlorate manufacture, bleaching-powders and bleaching-liquors, made either by Deacon's process, Weldon's process, or the old process, have all yielded manganese on analysis, and the corresponding pink solutions, when examined by the aid of the micro-spectroscope, have all given the characteristic absorption spectrum of potassium permanganate—the five well-known bands in the yellow and green.—I am, &c.,

GEORGE E. DAVIS.

30, Faulkner Street, Manchester.

PROF. DITTMAR AND THE "ANALYST."

To the Editor of the Chemical News.

SIR,—My object in troubling you with my former letter was to do an act of justice to Prof. Dittmar, viz., to prevent the assailants of Prof. Dittmar from passing off their own private act as the public act of a Society which refuses to take part in it; and my position as one of the Vice-Presidents of that Society, and as chairman of the meeting which condemned the attack on Prof. Dittmar, made it my clear duty to interfere.

As I have already mentioned, the *Analyst* was registered in the names of Mr. Wigner and Dr. Muter as proprietors, and in the last resort the control of the paper and the legal responsibility rest with these two persons.

The six persons forming the Committee of Publication are the President of the Society (Dr. Redwood), myself, Dr. Muter, Dr. Dupré, Mr. Heisch, and Mr. Wigner. The editorship of the *Analyst* is in the hands either of Mr. Wigner or of some person in his employ.

I have the permission of the President (Dr. Redwood) to record that the article under discussion was published without his knowledge or consent. I take this opportunity of formally recording that it was published without my knowledge or consent; and in his letter which appeared in the *CHEMICAL NEWS* (vol. xxxiv., p. 162) Dr. Muter has disclaimed all knowledge or consent. I call attention to the circumstance that in the letter signed conjointly by Mr. Heisch and Dr. Dupré those gentlemen omit to say whether they were present at any committee meeting sanctioning the issue of the article on Prof. Dittmar, and confine themselves to a general expression of responsibility: and with all these facts before them I do not doubt that the real character of the attack on Prof. Dittmar will be obvious to your readers.—I am, &c.,

J. ALFRED WANKLYN.

117, Charlotte Street, Fitzroy Square, London, W.
October 24, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 14, October 2, 1876.

Industrial Application of the Sun's Rays.—M. A. Mouchot.—The author presents to the Academy a small "solar alembic," easy to set up and to remove. The mirror is 50 c.m. in diameter; the boiler contains 1 litre of wine, which is brought to a boil by half an hour's exposure to the sun. The vapour of alcohol enters a tube placed in the centre of the boiler, traverses the foot of the mirror, and descends into the worm, where it condenses. The foot of the mirror is a gas-tap fitted with a groove and a set-screw, which permit the boiler to be always turned to the sun. If the boiler is filled with water, and if a receptacle full of leaves or odoriferous flowers is interposed between it and the worm, all the essences procurable by distillation may be obtained.

Influence of Temperature upon Magnetisation.—J. M. Gauguain.—Not suitable for abstraction.

Chemical Reactions of Gallium.—M. Lecoq de Boisbaudran.—Solution of pure gallium, mixed with acid acetate of ammonia, are not rendered turbid by sulphuretted hydrogen, but if zinc is present the sulphide of this metal is charged with gallium, but the liquid is not entirely freed from it. If the salts of zinc are not plentiful enough to draw down at once all the gallium precipitable by sulphuretted hydrogen, it must be added in small portions

until these products no longer give the ray $G_{a\alpha 4170}$ in the spectroscope. Only slight traces of gallium remain then in the liquid. On proceeding thus, the amount in the precipitates appears to remain at first almost constant, or at least to decrease slowly, and then more and more rapidly: it does not, therefore, seem to be a function of the amount of gallium in the liquid. Is there not here an indication of a combination between the two substances, or perhaps more probably a surface-attraction analogous to the fixation of a colouring matter upon a mordant. It is known that salts of zinc slightly acid are precipitated by sulphuretted hydrogen, the action being limited by the quantity of strong acid set at liberty. If the experiment is made with a chloride of zinc containing gallium, a notable quantity of this metal falls along with the sulphide of zinc. An ammoniacal solution of the salts of gallium and zinc is precipitated by hydrosulphate of ammonia. An excess of the reagent does not remove the gallium, unless, indeed, the sulphide of zinc is in such small quantity as to dissolve also. The case is different when the salt of gallium is pure. The ammoniacal solution is not rendered turbid by the sulphide of ammonium. If a neutral or slightly acid solution of the chlorides of zinc and gallium is submitted to fractionated precipitation with sulphide of ammonium containing free ammonia, the gallium is concentrated in the first products. If an ammoniacal solution of zinc and gallium is submitted to the same treatment, the gallium, on the contrary, accumulates in the last precipitates.

Syphonment and "Migration" of Gases.—M. F. Bellamy.—The phenomena classed here as "migration" are cases of gaseous osmose. The author has given them the name of "migration" to distinguish them from osmose, properly so-called, which is effected through *septa*, conductors of large surfaces and very small length. In "migration" the conductor presents a narrow surface and a length relatively great.

Bulletin de la Societe Chimique de Paris,
Nos. 4 and 5, September 5, 1876.

Transformation of Aromatic Carbides into Formenic Carbides.—M. Berthelot.—The author remarks that in effecting total hydrogenations with hydriodic acid and phosphorus, red phosphorus should not be used, since it dissolves completely at the temperature required, and gives rise to such a great formation of gas that the tubes cannot be preserved.

Thermo-chemical Researches on Lead and Thallium.—M. J. Thomsen.—(*Journal fur Praktische Chemie.*)

Thermo-chemical Researches on Copper and Silver.—M. J. Thomsen.—These two papers consist merely of columns of formulæ and figures.

"Action of Mass" of Water.—M. W. Ostwald.—The author has studied the decomposition of bismuth chloride by water increasing with the quantity of the latter.

Borates of Lithium.—M. F. Filsinger.—The author has obtained a baborate and four other compounds, or possibly mixtures.

Crystalline Fluosilicates of Iron and Cobalt.—M. F. Stolba.—The author prepares the former of these two compounds by dissolving metallic iron in hydro-fluosilicic acid, and the latter by decomposing the carbonate of cobalt with the same acid.

Purification of Bisulphide of Carbon.—M. L. H. Friedburg.—The author distils the sulphide over a pure vegetable fat, such as palm oil. To free the sulphide of carbon from a little fatty matter which it carries over, it is poured into fuming nitric acid, stirred, and allowed to digest for twenty-four hours. It is then mixed with cold water, distilled at 50° or 60° , mixed with water again, and re-distilled, when it is obtained perfectly pure.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Quercitrin and Quercetin.—M. J. Lœwe.—Quercitrin is generally regarded as a glucoside which is split up under the influence of acids into quercetin and sugar (the isodulcite of Hlasiwetz and Pfaundler). The author combats this view, and seeks to demonstrate that quercetin differs from quercitrin merely by containing two equivalents of water less.

Density of Nitric Acid at Different Temperatures.—M. H. Goebel.—A table showing how the hydrometric value of nitric acid is affected by changes of temperature.—*Dingler's Polytechnisches Journal.*

Researches on the Kainite of Kalusz in Galicia.—M. H. Schwarz.—There are found at Kalusz deposits of pure sylvine (chloride of potassium) and of kainite. This latter is found in yellowish grey fragments, generally moist from the presence of chloride of magnesium. On analysis it is found to be a tolerably constant mixture of the double sulphate of potassium and magnesium (picromerite or schœnite), chlorides of sodium and magnesium, and clay in variable quantities.

New Process of Dyeing with Artificial Alizarin.—M. R. Forster.—The author fixes first the aluminous mordant, and then a mixture of alizarin and of fatty acid, by operating as follows:—He dissolves a sufficient quantity of alizarin and of soap, and then neutralises the solution with sulphuric acid. The alizarin and the fatty acid are precipitated in very finely divided flocks, which attach themselves very readily to the mordanted tissues, giving very bright and solid colours.

Distinctive Reaction between Reds from Artificial Alizarin and those from Extract of Madder.—M. J. Wagner.—The author finds that extract reds are very much injured by a mixture of soda and potassic ferricyanide, whilst artificial alizarin-reds are scarcely affected. This difference is doubtless due to the presence of purpurin in the extract which is destroyed by this reaction.—*Bulletin de Mulhouse.*

Solution of Damaged Albumen in Pepsin.—M. J. Wagner.—The author utilises damaged lots of albumen by dissolving them in pepsin. The solutions thus obtained give, according to his account, colours almost as solid as albumen of the first quality. Nevertheless, the albumen thus re-dissolved is no longer coagulable by heat, and the degree of solidity of the colours fixed by its intervention is not comparable to that of colours fixed by unmodified albumen. The process, therefore, is only applicable in certain cases.—*Moniteur de la Teinture.*

Formation of Aniline-Black.—M. Rich. Meyer.—An acid solution of pure aniline sulphate gives, on the addition of a concentrated solution of MnO_4K , a deep olive-green precipitate, verging upon black, but which cannot be totally deprived of sulphuric acid. The author considers that the original precipitate is a sulphate which is gradually decomposed by washing. This body presents the general characters of aniline-black. It is insoluble in alcohol, ether, benzol, and acetic acid, to which, however, it still imparts a more or less olive tint. Concentrated sulphuric acid dissolves it with a black-blue colour, but it is re-precipitated on the addition of water. If the sulphuric solution is heated SO_2 escapes, and the liquid becomes a dirty brown. Further researches are required to ascertain if this black is identical with that of M. Coquilhon and M. Goppelsröder.

On Litmus.—M. V. Wartha.—The blue colouring matter, indifferent to acids, often found in blocks of litmus, is simply indigo, which, in the author's opinion, is intentionally added to heighten the blue colour. It may, however, result from the fermentation of the lichens at the expense of the urine added.

County Analyst for Warwick.—On the 17th inst. Mr. A. Bostock Hill, M.D., was elected Analyst for the County of Warwick.

MISCELLANEOUS.

University of Oxford.—The following are the lectures to be delivered during the present term:—"Organic Chemistry (Phenic Compounds)," on Mondays and Thursdays, at noon, at the Museum, by the Waynflete Professor of Chemistry, Dr. W. Odling, M.A. Lectures "On Elementary Organic Chemistry" are given by the Aldrichian Demonstrator of Chemistry, Mr. W. W. Fisher, M.A., of Corpus Christi College, on Wednesdays and Saturdays, at 11 a.m.; and lectures "On Elementary Inorganic Chemistry," by Mr. W. F. Donkin, M.A., of Magdalen College, on Tuesdays and Fridays, at 11 a.m. The instruction in the Laboratory of the University, which is open from 10 a.m. to 4 p.m. daily, is given by the Aldrichian Demonstrator, and by Mr. John Watts, D.Sc. A Course of Practical Instruction in Organic Chemistry is conducted by Mr. W. H. Pike, Ph.D. The Professor will be glad to hear from gentlemen who, having passed the necessary examinations for the degree of Bachelor of Arts, wish to carry on original work in the University Laboratory.

NOTES AND QUERIES.

Fluoride of Potassium.—Having seen a question asked for a ready process for the production of fluoride of potassium I should feel obliged if you would kindly allow me to give the following process which might be found of some use to "Fluorine."—By using a small leaden vessel having a diameter at the bottom $\frac{3}{4}$ ", and $2\frac{1}{4}$ " at the top, to hold a pint, to which a cover is attached with two holes bored in it, one for putting the mixture through and the other for the delivery tube. 2000 grms. of fluor-spar is now placed in the leaden vessel in the state of small lumps, as it will be found to operate better in this state than powdered. 100 grms. of sulphuric acid to 20 grms. of water is then poured upon it; the hold is now plugged with a gutta-percha cork, and a tube put through a similar cork and placed in the other hole. Hydrofluoric acid is now given off by being allowed to pass into the vessel containing the potassium, with which it forms a fluoride, as the potassium eliminates the hydrogen. P.S.—I may add, heat is applied matter of course it boils at 194° = hydrofluoric.—LATENT.

MEETINGS FOR THE WEEK.

THURSDAY, Nov. 2nd.—Chemical, 8. "On some New Compounds of Potassium," by Sidney Lupton. "On certain Bismuth Compounds" (Part III.), by M. M. Pattison Muir. "On Phospho- and Arsenio-Cyanogen," by W. R. Hodgkinson. "On a Secondary Oxidised Product formed during the Reduction of Stannic Chloride," by W. R. Hodgkinson and G. C. Matthews. "Preliminary Notice on Pigmentum Nigrum, the Black Colouring Matter contained in Hair and Feathers," by W. R. Hodgkinson and H. C. Sorby. "On Barwood," by the late Dr. Anderson.

TO CORRESPONDENTS.

R. P. Davis.—It was a printer's error. See erratum. ERRATUM.—In No. 881, p. 155, col. 1, l. 34 from top, for 28.88 per cent ZnO_2 read 28.88 per cent Fe_2O_3 .

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VOL. XXXIV. No. 884.

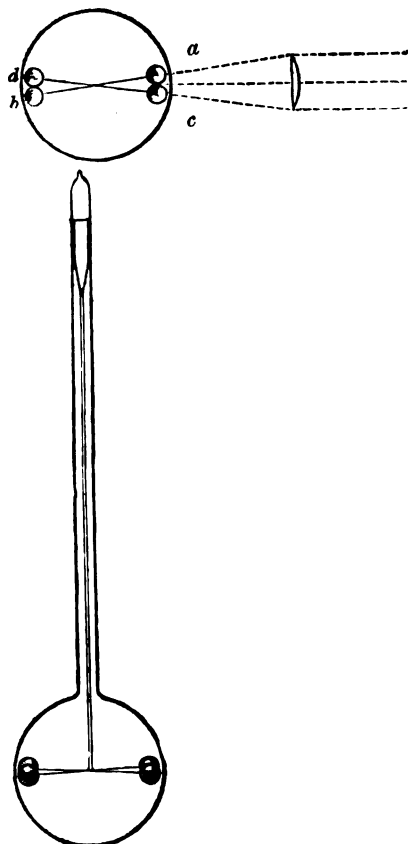
ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 176).

90. EXPERIMENT proves the above reasoning to be correct. A bulb-tube was prepared in the manner already described (84), but in it were suspended, by separate silk fibres, two glass stems, each having pith balls at its extremity. Fig. 3 shows the elevation and plan of the apparatus. The torsion of the silk fibres was so arranged that the pith balls *a b* hung freely about a millimetre from the balls *c d*. The glass stems were looped in the middle, and bent so that they did not touch each other. After complete exhaustion the following experiments were tried.

FIG. 3.



A beam of radiant heat was concentrated on to the two balls *a c*. When applied momentarily and then removed

the radiation simply drove the balls apart, and immediately allowed them to come together again. When, however, the beam was allowed to play upon the balls for about half a minute they became warm and widely separated; and upon now removing the beam of heat the balls did not fall together at once, but took several minutes to regain their original position. This experiment therefore proves Case I.

The bulb and contents being of the ordinary temperature, a spirit-flame was rapidly passed round the bulb to warm it quickly on all sides. The balls were thus in the condition imagined in Case II., being in a space warmer than themselves. They immediately came together, *a* touching *c*, and *d* touching *b*.

Many experiments were tried with the object of proving experimentally the propositions in Cases III. and IV.; but with this apparatus it was found impossible to warm one of the balls without at the same time producing repulsion of the ball by the beam of radiation concentrated upon it. There is, however, little doubt, from the experimental proof of Cases I. and II., that the reasoning is equally correct in the other cases.

91. With a highly exhausted bulb and light pith index, which was found to be exceedingly sensitive to radiation, numerous experiments were tried to see if there was any difference in action between the fingers and a tube of water of the same temperature. Many persons believe that there is a peculiar emanation or *aura* proceeding from the human hand, and Baron Von Reichenbach* considered that he had proved this to be the case. Were this true it was not impossible that the emanation would affect the pith index. I have been unable, however, to detect the slightest action exerted by my own or any other person's hand which I could not entirely explain by an action of heat.

92. A similar series of experiments were tried with various large crystals, which were presented in different ways and with various precautions to the pith index. At first a decided action was observed; but in proportion as precautions were taken to eliminate the effect of heat, so was the action seen to diminish, until very little doubt was left in my mind that the slight residual action would have been entirely stopped had it been possible, with the apparatus then used, to altogether eliminate the action of heat.

93. Attempts were made to see if chemical action would attract or repel the index. I could not, however, produce chemical action close to the exhausted bulb, without at the same time liberating such an amount of heat as to mask any other action.

94. Although I most frequently speak of repulsion by heat, and in illustrating any of the results obtained I generally use either the fingers or the flame of a spirit-lamp as a convenient source of radiation, it must be clearly understood that these results are not confined to the heating-rays of the spectrum, but that any ray, from the ultra red to the ultra violet, will produce repulsion in a vacuum. I have already mentioned this fact in my first paper (58, 68). Experiments proving the similarity of action of all rays of the spectrum were shown before the Physical Society on June 20, 1874.† They were, however, tried with a less perfect apparatus than the one I have since used for the same purpose, and need not be further alluded to till I describe the most recent results obtained with the spectrum (110, 111).

95. Some experiments were tried with the object of ascertaining whether the attraction by heat, which, commencing at the neutral point (30 *et seq.*), increased with the density of the enclosed air, would be continued in the same ratio if the apparatus were filled with air above the atmospheric pressure. Two bulbs containing ivory needles suspended by silk fibres were accordingly adjusted to show the same sensitiveness to a hot body. One was

* A Paper communicated to the Royal Society, March 20, 1875. From the *Philosophical Transactions of the Royal Society of London*, vol. clxv., pt. 2.

* "Researches on Magnetism, &c.," translated by Dr. Gregory. London, 1850.

† *Phil. Mag.*, August, 1874.

kept for comparison, and the other was attached to an apparatus whereby the internal air-pressure could be artificially increased by a column of mercury. A little increase of pressure was enough to show that the sensitiveness to radiation was greater; and under a pressure of $1\frac{1}{2}$ atmosphere the superior delicacy of the ivory in the dense air was very marked. Attempts to carry the pressure to higher points failed, owing to the bursting of the thin glass bulbs. With a little different arrangement no difficulty would be experienced in carrying the experiments to a much higher point; but hitherto the greater interest attending the vacuum experiments has prevented me from working further in this direction. My friend and pupil, Mr. C. H. Gimingham, succeeded in the very difficult feat of sealing up some of these tubes under an internal pressure of $1\frac{1}{2}$ atmosphere.

96. To carry this experiment a step further bulbs containing a suspended ivory or mica index were filled with carbonic acid gas, water, carbonic disulphide, ether, alcohol, and other liquids. The index in carbonic acid behaved as if it were in air of somewhat higher density than the atmosphere; movements were also obtained when the liquids were present, but they were so obviously due, in whole or in greater part, to currents, that they proved nothing of importance.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 181.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

THE bromine lyes are kept in a large reservoir situate above the stills, in which they can be preliminarily heated by means of a coil of steam pipe. The height of the liquid is indicated by a float to which is attached a cord passing over a pulley and supporting at its other extremity a weight suspended in front of a scale, so that the workman in charging the stills is guided by the movements of this weight.

The stone lid is closed by its own weight, but may be further loaded with extra weights; the joints are made good with plastic clay. As we have already mentioned, the cover is raised by means of a counterpoise, but only when the apparatus is filled anew with manganese. The charge is about 4 cwts., which quantity serves for an entire series of operations. Not all qualities of manganese are fit for this purpose, that of medium hardness being the most suitable. The charges of bromine liquor and of sulphuric acid are introduced through one of the small apertures in the stone cover, which is immediately afterwards closed with balls of clay held down by iron weights. As soon as the apparatus is thus suitably secured steam is turned on and bromine vapours immediately escape in abundance through the leaden tube cemented into the second aperture in the cover. This leads to a worm surrounded with cold water in which the bromine is condensed. The original leaden worms have long ago been replaced by a stoneware apparatus.

At first the excellent but very costly stoneware worms of the English establishment "Lambeth Potteries," were used, but latterly German apparatus have been employed, especially those furnished by the firm of Jannasch, in Bernburg. The lower end of the stoneware worm opens by means of a bent glass adaptor into the central tubulure of a large three-necked Woolf's bottle holding about

8 litres, in which bromine and bromine-water collect. Into one of the lateral necks is fixed a movable glass syphon, by means of which the bromine-water can be drawn off into stoneware jugs. From the other neck a bent glass pipe passes down to the bottom of an iron vessel, which widens upwards in a conical shape and which is filled with water and iron turnings. Vapours of bromine which have not been condensed in the bottle are arrested by the iron. The impure chloriferous bromide of iron, as well as the bromine-water syphoned off are returned to the stills for the next operation.

At the beginning of the process scarcely anything but bromine is evolved, afterwards chloride of bromine escapes, and ultimately, when there is no more bromine in the apparatus, pure chlorine is evolved. Dr. Frank, for the instruction of the author, kindly caused an operation to be carried to the very end so that the three stages of the process, which are easily distinguished by the colour of the gas in the glass adaptor, were fully exhibited. In the ordinary routine of the works the operation is stopped when the chloride of bromine begins to be given off. The workmen in these establishments receive in addition to their wages a premium on the quantity of bromine obtained. Hence it is their interest to get through the greatest possible number of operations, and as the bromine lye is on hand in abundance they break off the operation as soon as the distillation of the bromine slackens. The quantity of sulphuric acid also is so calculated that it only just suffices for the liberation of the bromine in a charge. Hence the bromine obtained ought to be free from chlorine. It is found, however, in practice that, on account, doubtless, of the imperfect mixture of the reagents chloride of bromine is evolved even in the earlier stages of the distillation. The quantity of acid (hydrochloric acid?) must also be noticed which is given off towards the end of the process and produces such an evolution of hydrogen in the iron vessel that its contents froth strongly. In order to prevent loss by running over a broad saucer-shaped rim is cast on the iron at the distance of some centimetres from its upper margin in which the overflow collects and is conducted away by a side tube into a stoneware jug.

Each operation takes up about two hours and yields from 2 to 2.5 kilos. of bromine. The two bromine works at Stassfurt are so arranged that they are capable of producing 500 kilos. in twenty-four hours, but this quantity has never been actually furnished.

(To be continued.)

THALLENE: ITS SOURCE, AND THE HISTORY OF ITS DISCOVERY.

By HENRY MORTON, Ph.D.,

President of the Stevens Institute of Technology.

As the new hydrocarbon, thallene, which I succeeded in isolating and investigating in 1872-3, is now being produced on something approaching a commercial scale, though in a very impure state, some points in reference to its source, and the actual history of its discovery, may be of interest at this time.

Petroleum is ordinarily distilled from first to last in two stages.

In the first place, it is heated in large stills until all the lighter oils, consisting chiefly of benzine and the burning oils, are driven off, and there is then left a residuum or petroleum tar, of a density of about 20° B. This residue or tar is then transferred to other stills, in many cases run by other parties, and is again distilled for the production of lubricating oils and paraffin.

At the end of this operation, when the bottom of the still is already red-hot and some coke has been formed, the runs very slowly from the condenser a thick yellow-brown tar, which is almost solid in cold weather, and in summer

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

only semi-fluid. Much of it seems to lodge permanently in the heads of the stills, and my friend Prof. S. P. Langley, of Pittsburgh, once secured me a barrel of it by having the still-heads blown out with steam.

This thick tar, prior to 1873, was only used as a lubricant for the necks of rolls in rolling-mills, its great tenacity securing its adherence under the very unfavourable conditions to which it was there exposed.

About March, 1873, however, Mr. John Truax, of Pittsburgh, wrote me as follows, referring to this tar, a considerable quantity of which he had before sent me from his own works:—

"Within a few months we have found a new use for it in the manufacture of a lubricating oil, and we are trying in every direction to obtain it. When we shall have our new works in order—in the course of a couple of months—we can let you have as many specimens as you want."

It is this substance which contains thallene, and from which I extracted it. My attention was first drawn to it in the following way:—

In the early part of 1872 I was engaged in the systematic examination of various fluorescent bodies, and one day in February Prof. E. N. Horsford calling upon me, I showed him some of these, and he then mentioned that he had brought from Pittsburgh a highly fluorescent tar, which he would send to me.

Shortly afterwards about half an ounce of the yellow tar, enclosed in a bottle, was sent to me by Prof. Horsford from Cambridge. The bottle was broken in transit, and I presume that part of the contents escaped. There was, however, enough for me to examine so far as to show that a solid crystallisable hydrocarbon could be extracted from the yellow tar. For convenience of reference I called this "viridine," from its green colour and fluorescence, and made a preliminary note of it in a paper which I read before the American Institute in New York on March 29. Wishing to carry my investigations further, I wrote to Prof. Horsford for a further supply, and in answer received the following note:—

"New York, March 2, 1872.

"MY DEAR SIR,

"I am sorry the phial met with mishap. You might obtain more from Dr. Herbert C. Tweddle, Pittsburgh, I presume.

"The body that gives the fluorescence seems to me to reside in the yellow semi-fluid substance. You will occasionally see streaks of green in it. I hope it may be useful to you in your investigations.

"I am, very truly yours,
"E. A. HORSFORD."

On receipt of the above letter I wrote at once to Dr. Tweddle, describing the tar sent me by Prof. Horsford, and he then and subsequently promised to send me a quantity, but never did so. In the meantime, my friend Dr. G. F. Barker, then of New Haven, who had also brought some of the same tar from the works of Mr. John Truax, of Pittsburgh, hearing of my destitution, sent me part of his specimen to see if my new body was in it, and on my finding that it was he wrote to Mr. Truax to send me a large quantity. This Mr. Truax did promptly, and on my further advising him how to purify it he sent me some pounds of the new material, extracted from the tar as a dark olive-green solid mass.

It was with the material so received by me from Mr. Truax that I made my investigations, already published, which ended in establishing the individuality of a new hydrocarbon, resembling in many points anthracene, but fusing at 460° F., and forming compounds with chlorine, bromine, oxygen, picric acid, &c., entirely unlike the corresponding derivatives of anthracene.*

Not having facilities in my own laboratory at that time for such work, I was indebted to the kindness of my friend Dr. G. F. Barker, then of New Haven, for a combustion

of this new substance, which indicated that it was probably isomeric with anthracene.

A specimen of the same material was kindly conveyed by my friend Dr. H. C. Bolton, to Dr. Tiemann, of Berlin, who made two combustions of it with the following result:—

I. 0.2821 grm. thallene gave 0.1430 H₂O = 5.63 p.c. H.
II. 0.2750 " " " 0.1412 H₂O = 5.70 p.c. H.
I. 0.2821 " " " 0.9622 CO₂ = 93.02 p.c. C.
II. 0.2750 " " " 0.9384 CO₂ = 93.06 p.c. C.
Anthracene requires—H, 5.62; C, 94.38.

However, I by no means consider that I have exhausted this subject, and hope to be able to give a rational formula for thallene before long.

Among the articles constituting the exhibit of the Stevens Institute of Technology in the Centennial Exhibition at Philadelphia are the following preparations and compounds of thallene:—

- I. Crude thallene washed with benzin.
- II. Crude thallene washed with benzin and hot alcohol.
- III. Thallene purified by repeated crystallisations from benzol.
- IV. Thallene as above re-crystallised from hot alcohol.
- V. Thallene chinone.
- VI. Thallene chloride.
- VII. Thallene bromide.
- VIII. Thallene picrate.
- IX. Sublimed thallene.
- X. Solarised thallene.

Within the last few weeks I have received from Dr. H. W. C. Tweddle (the same gentleman from whom I was not able to procure any material with which to carry out my investigations four years ago) a series of solid bodies, to which he has given a variety of names, but which seem to consist simply of thallene in a greater or less state of purity.

In the first place, under the name of petrocene, he sends me a quantity of the product obtained by washing thallene-tar with benzin or petroleum naphtha. This was the first step of my process, published in 1872 (see CHEM. NEWS, vol. xxvi., p. 272), and, as might be expected, yields a product containing, it is true, some thallene, but contaminated with a large amount of uncrystallisable tarry matter and other impurities, which can be separated by washing with hot alcohol and repeated crystallisation from solution in hot benzol (coal-tar naphtha) in the manner described by me at first.

Together with the above, Dr. Tweddle sends me a series of products which he has obtained by distilling the same, and separating from time to time what passed over, as the temperature of the still rose.

The last but one of these products, which Dr. Tweddle finds to have a melting-point of 460° F., which was the melting-point found by me for thallene in 1872 (see CHEM. NEWS, vol. xxvi., p. 274), appears to be a tolerably pure specimen of thallene, yielding by two crystallisations from benzol a clear yellow substance characterised by the peculiar fluorescent spectrum and other physical properties by which this substance was first recognised. The other materials obtained at lower temperatures, prove to consist of thallene mixed with greater and greater amounts of the tarry substances and other matters which are removed by the process of crystallisation from hot benzol. Dr. Tweddle's last or highest product seems to be a mixture of thallene with carbon and other matters, the result of a partial decomposition caused by exposure to too high a temperature.

While it is interesting to find that by working on large quantities of a material a partial separation of thallene from other substances accompanying it may be effected, my observation of these products would not lead me to recommend it as a desirable method of obtaining pure thallene.

The best of the products sent me by Dr. Tweddle yielded

* See CHEM. NEWS, vol. xxvi., p. 272; *Monit. Scient.*, vol. xv., p. 356; *mer. Chem.*, vol. iii., p. 162; *Phil. Mag.* xlv., p. 89; *Poggendorff's Annalen*, vol. clv., p. 551.

in benzol a dirtier and less pure solution than I obtained from the material supplied me by Mr. Truax when that had been well washed with benzin.

Dr. Tweddle's material, according to his own description, was also washed with benzin before it was distilled, so that nothing was saved here, and evidently a considerable amount of the thallene must have been decomposed in the process of distillation. To obtain anything like a pure product crystallisation from hot benzol must, moreover, be resorted to at last.

I have now on hand a large quantity of purified thallene extracted from a barrel of the tar which was secured for me by the kind exertions of my friend Prof. S. P. Langley, of the Allegheny Observatory, and with this I am conducting a thorough investigation of its chemical properties and derivatives.

NOTES OF WORK BY STUDENTS OF
PRACTICAL CHEMISTRY
IN THE
LABORATORY OF THE UNIVERSITY OF
VIRGINIA.

No. V.

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.
(Concluded from p. 180.)

(5.) *Analysis of a Stove-Pipe Deposit.* By S. D. CREN-
SHAW, of Orange Co., Virginia.

In one of the working rooms of the Laboratory a "base-burning" stone, burning Pennsylvania anthracite and fed by gravity from a central hopper, is kept alight during the whole winter both by day and night. The stove-pipe, of common Russia sheet iron, rises about 12 feet vertically, and then runs horizontally about 24 feet before entering the chimney. When, in cold weather, the fire is burning slowly and draughts of cold air are allowed to enter the room from the doors, some of the products of combustion are condensed and come to the outside of the pipe at the joints, running slowly down the outside as a thick, orange-yellow, liquid mass in little streams of $\frac{1}{4}$ to $\frac{1}{2}$ inch wide. In the course of three or four days such a deposit hardens into an opaque mass of light brownish yellow colour.

Qualitative examination proved that this consisted essentially of ammonium sulphate and free sulphur, with small quantities of ferrous sulphate, free sulphuric acid, and a hydrocarbon apparently of one of the higher series. A portion of the material was completely oxidised and the total sulphur determined as barium sulphate; the amount of barium sulphate yielded by another (unoxidised) portion treated merely with water was also ascertained, and the difference gave the means of calculating the free sulphur. Ammonia was determined in the cold by Schlösing's method. It was ascertained that the iron was present altogether as a ferrous salt; it was then fully oxidised and determined as Fe_2O_3 . The carbon and total hydrogen (there being also nitrogen and sulphur present) were determined by combustion with cupric oxide aided by a small amount of potassium chlorate, and the gases were passed over heated lead chromate and reduced copper turnings respectively. The oxygen of the water was obtained by difference. The results were:—

$(\text{NH}_4)_2\text{SO}_4$	.. .. .	80.48
FeSO_4	.. .. .	3.73
H_2SO_4	.. .. .	0.64
S	.. .. .	7.35
C	.. .. .	1.34
H comb. with C	.. .. .	0.11
Cl	.. .. .	trace
SiO_2	.. .. .	0.12
H_2O}	.. .. .	6.23
		100.00

The deposition of free sulphur, doubtless as a result of the reducing action at a low temperature of the stove-pipe iron upon sulphur dioxide, is interesting; probably the reaction instead of $\text{Fe}_2 + 2\text{SO}_2 = \text{FeSO}_4 + \text{FeS}$, which occurs when the materials are more strongly heated, is $\text{Fe} + 2\text{SO}_2 = \text{FeSO}_4 + \text{S}$.

(6.) *Analysis of the Ash of Hard Carbon Deposited in Coal-Gas Retorts.* By W. VAN SLOOTEN, of New Orleans, Louisiana.

The hard and heavy mass of carbon which encrusts the inside of a gas retort for some time in use, and which results from the decomposition of volatile hydrocarbons produced during the distillation, forms an admirable fuel for laboratory furnaces, in which a very high temperature is to be attained, this use having been first suggested by Violette (*Comptes Rendus*, October 28, 1872, p. 1028). Its value depends partly upon its high density, but chiefly upon the small quantity of ash which it leaves when burned, so that the intervals between the fragments of fuel do not become choked nor the draught of air obstructed. Mr. van Sooten undertook to determine the amount of ash in specimens of this carbon taken from a lot of several tons obtained from the gas works of Richmond, Virginia.

Small fragments of the material were burned in a stream of oxygen gas, supporting them on platinum foil in a hard glass tube. The combustion was not very easy to manage, since too slow a supply of oxygen readily led to the dense carbon ceasing to glow, while a little faster stream swept away the light particles of ash. It soon appeared that different layers of the deposit varied considerably in the amount of ash. Thus three specimens gave—

No. 1	.. .. .	1.66 per cent
No. 2	.. .. .	0.35 "
No. 3	.. .. .	0.95 "

while another sample, dull and earthy in appearance, from the gas works of Charlottesville, Va, gave—

No. 4		3.77 per cent
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The ash from this last was analysed, it having proved excessively tedious to get enough of either of the others. The results were:—

SiO_2	.. .. .	42.00
Fe_2O_3	.. .. .	47.00
Na_2O}	.. .. .	8.57
Li_2O}	.. .. .	trace
Cl	.. .. .	3.72

		101.29
Deduct O equiv. to Cl	.. .. .	0.84

100.45

The trace of lithium was detected by the spectroscope in the flame of the furnace.

The immunity from clinker or accumulation of ash in the furnace is seen to be due not always to the existence of a very small proportion of mineral matter in the fuel, but also to the very light condition in which this separates and is swept up the chimney with the draught. The occurrence in some cases of so considerable an amount of the not readily volatilisable elements silicon and iron in this retort carbon is not very easy to explain, and rather suggests the mechanical carrying forward of solid particles with even the comparatively gentle rush of combustible gas escaping from the coal.

(7.) *Production of Metallic Zinc free from Iron and Carbon, for Analytical Use.* By R. D. BOHANNON, of Mathews Co., Virginia.

On the whole, metallic zinc is the most convenient material for reducing ferric to ferrous sulphate in the often recurring volumetric determination of iron by potassium permanganate. For this purpose we must have the metal

perfectly free from iron and carbon, a condition in which it is almost impossible to procure it in commerce, even from the professed dealers in pure chemicals, while the purification by distilling out of contact of anything which can yield either of the elements to be removed is not an easy or convenient laboratory process. It is true that zinc containing iron might be used if the amount of the latter were certainly known, and known to be *uniform*, but this can scarcely be depended on. Mr. Bohannon has tried the production of the pure metal from the chloride (free from iron) by means of sodium, and with fairly satisfactory results.

Commercial zinc was dissolved in crude hydrochloric acid, the solution diluted, and sulphuretted hydrogen passed through to saturation. The clear liquid was filtered off from the precipitate of lead sulphide, &c., after standing for twenty-four hours, heated to the boiling-point, and treated with nitric acid enough to peroxidise all the iron present, which was then precipitated by the addition of ammonia until a portion of the zinc had been thrown down. After again standing for twenty-four hours, the solution was filtered off, evaporated to dryness, and the fused zinc chloride broken into small fragments. These were mixed with bits of metallic sodium and thrown into a previously heated and clean earthen crucible. The reaction was so violent that most of the zinc was volatilised and lost, but it was found that this could be prevented by previously diluting the fused zinc chloride either with sodium chloride or zinc oxide to a moderate extent. The metal obtained was quite free from iron (and of course from lead, copper, &c.) but afforded a trace of carbon derived from a little naphtha still adherent to the fragments of sodium used. This is easily prevented by careful drying of the larger pieces with a cloth, and then cutting off the outside crust. As regards the yield, 1·9 ozs. of pure zinc was obtained with an expenditure of 2·0 ozs. of sodium, but it was found necessary to have much more zinc chloride present (as a protective covering from the air) than the sodium was capable of reducing.

University of Virginia,
August 28, 1876.

NOTE ON DR. DAVY'S TEST FOR THE PURITY OF CHLOROFORM.

By DAVID B. DOTT.

In the *CHEMICAL NEWS* (vol. xxxiv., p. 137) appears an interesting and valuable paper on a "New Chemical Test for Alcohol," by Dr. E. W. Davy. In that contribution, however, there are some remarks of a misleading nature, which I think ought not to be allowed to pass without correction. The first statement to which I would take exception is the following:—"As regards chloroform, one of its common impurities is ethylic alcohol, which it may contain either from imperfect preparation or from fraudulent addition, the very high price of chloroform offering a great temptation to the unscrupulous vendor to increase its bulk or weight by the addition of alcohol." Now, it is manifest that as the specific gravity of pure chloroform is at least 1·500, while the British Pharmacopœia gives 1·490 as its standard specific gravity, the official chloroform must of necessity contain alcohol. It is therefore altogether erroneous to assert that the alcohol is present either "through imperfect preparation or fraudulent addition," the real reason for its addition being the prevention of decomposition in the chloroform. It appears that this new test can detect the presence of 1 part of spirit in 1000 parts of chloroform; but as the addition of 1 part of spirit to 2000 parts of chloroform reduces the gravity by about 0·001, the specific gravity would seem to be a more delicate test of the presence of alcohol than is molybdcid acid. Dr. Davy informs us that "he was unable to obtain any sample of chloroform in commerce sufficiently pure

not to give a blue reaction with the molybdcid test, owing to the minute quantities of volatile oils and other impurities they contain." I think I shall be able to show that this blue reaction is due simply to the presence of alcohol, and not to volatile oils or similar impurities. In the first place, I examined a sample of the ordinary unreduced chloroform prepared from ethylic alcohol by Messrs. J. F. Macfarlan and Co., and found that it gave *no trace* of blue coloration with the molybdcid test, while the reduced chloroform (sp. gr. 1·496) gave the characteristic alcohol reaction at once. I next procured some of the volatile oil obtained in the purification of chloroform, and treated it repeatedly with solution of calcic chloride, to remove the alcohol. When a drop of this oil was added to the molybdcid solution a pinkish tint was developed, but *no blue coloration*. I then mixed a drop of the purified oil with 1 drachm of pure chloroform, and submitted the badly-smelling mixture to the molybdcid test, with the result that *no colour whatever was produced*.

I trust that I have said sufficient to prove that Dr. Davy's strictures on the character of commercial chloroform are unwarranted, and that the impurity he has discovered is simply alcohol, which is not an impurity in the correct sense of the word.

93, Abbey Hill, Edinburgh.

ON ANTHRACENE TESTING.

By DR. FREDERICK VERSMANN.

(Continued from page 179).

I AM fully aware of the objections likely to be raised to my test. It will be said some confusion will arise in consequence, because the standard of valuation will be changed, inasmuch as my test will always indicate a lower percentage than the one now in use. My answer is—My test is more correct and more trustworthy; and at all events the buyers of anthracene are fully aware that the present quinone test does not give them the true value of the article, but only an indication, which they supplement themselves by further analysis.

The history of anthracene testing has been gradually progressive, from the alcohol to the bisulphide of carbon, and thence to the quinone test. Each of these modifications reduced the percentage, and was accompanied by an increase in the price of per cent, and if my test should be adopted the enhanced value of per cent will soon be regulated and find its level.

In looking at the first table it will be noticed that although the results found by the usual test range from 11·4 to 68·5 per cent, and that of the crystals from 6·6 to 63·2 per cent, the percentage of the powder fluctuates within very narrow limits. Omitting Nos. 2, 12, 28 on the one hand, and Nos. 9, 12, 26 on the other hand, the remaining 24 samples yield between 4 and 6 per cent of powder.

I have been very particular, as far as possible, to learn the history of all these samples, and I can fully account for the exceptionally low and high percentage in powder of the six samples; hence I am justified in neglecting them in the following considerations:—

The observation that a sample of the lowest quality yields nearly as much powder as another of the best quality, which last shows six times the amount of quinone by the usual test, is a strong confirmation of the well-known practical experience that the low per cent article is always of less comparative value than a better quality article.

Although this fact is well understood, it is but little acted upon, or the many low-quality lots would long have disappeared from the market. I think if the manufacturer can be clearly shown that a better quality article is more profitable he will after all improve his make, and as the buyers will take it all the more readily, I shall be

well satisfied if my experiments should in some degree contribute to an improved manufacture, the whole of which is, after all, in a very primitive state. It will then be interesting to prove the difference in value by actual experiment, and with that object the following results were obtained:—

There are two methods of improving the quality of anthracene, viz., by simple strong pressure, and by washing with suitable solvents of a number of impurities. As much oil as ever possible should be separated by pressure, because the oil retains much of the impurities which afterward yield the powder instead of quinone crystals; and, further, if an oily sample is washed at once much anthracene is lost by solution. Two very oily and poor samples were therefore first strongly pressed, the first once and the second twice, with the following result, viz.:—

alkaline filtrate remains of a deep orange colour, even after very prolonged washing with hot alkaline solution.

It will be unnecessary to further summarise the result of the above tables because it is very evident that the reduction in percentage formed by the usual quinone test is an apparent loss only, for the crystals alone show a sensible increase, and the powder a remarkable diminution.

Now to the second method of improving the quality of anthracene, viz., by washing, I have taken two samples of very different percentages, and have purified them in a similar manner as is usual on the large scale; the first table on next page gives the results.

1000 grms. of anthracene were taken in each experiment, and the quantities obtained were as follows:—

Effect of Pressing Two Samples of Anthracene.

		Crystals and Powder Mixed.		Crystals.		Powder.
1. Original	.. .. .	11'4	283	6'6	278	4'8 not at 300
			275—279		272—275	
Once pressed	.. .. .	20'6	277	17'8	277	2'6 not at 300
			273—275		275—276	
2. Original	.. .. .	15'2	276	10'2	278	280
			274—275		274—276	270—275
Once pressed	.. .. .	22'0	277	18'3	281	276
			273—275		273—277	262—269
Twice pressed	.. .. .	26'4	280	22'1	280	271
			274—277		276—278	261—266

300 grms. were taken in each experiment, which with the first sample were by once pressing reduced to 150 grms., while in the second series the 300 grms. were by twice pressing reduced to 192 and 160 grms. respectively. By multiplying these quantities with their percentages we obtain the following table of total per cent units, which are also reduced to 1000:—

No. 1. First treatment	.. ..	440 grms.
Second treatment	.. ..	190 "
No. 2. First treatment	.. ..	720 "
Second treatment	.. ..	510 "

By multiplying these quantities with their respective percentages we obtain the following table of total per cent

				Crystals and Powder Mixed.	Crystals.	Powder.
1. Original	..	..	300	11'4=3420 or 1000	6'6=1980 or 1000	4'8=1440 or 1000
Once pressed	..	..	150	20'6=3090 or 903	17'8=2670 or 1348	2'6= 390 or 271
2. Original	..	..	300	15'2=4560 or 1000	10'2=3060 or 1000	4'6=1380 or 1000
Once pressed	..	..	192	22'0=4224 or 925	18'3=3513 or 1170	4'0= 576 or 417
Twice pressed	..	..	160	26'4=4224 or 925	22'1=3536 or 1173	4'2= 672 or 487

Taking in all cases the percentage of "crystals and powder mixed" as 100, and calculating therefrom the proportion of crystals and of powder separately, we obtain the following table, which will show more clearly the effect of pressing:—

		Crystals and Powder Mixed.	Crystals.	Powder.
1. Original ..	..	100	57'9	42'1
Once pressed..	..	100	86'4	12'6
2. Original ..	..	100	67'1	30'2
Once pressed..	..	100	83'2	18'2
Twice pressed	..	100	83'3	15'9

Taking the crystals as pure quinone and the powder as impurity, retaining very little quinone, the effect of pressing is very striking, and it becomes pretty evident that no article giving less than 20 per cent of crystals should be found in the market.

The action of potassium permanganate and especially of potassium hydrate, points in the same direction, i.e., the lower the percentage of a sample the more oily and impure the sample the larger the proportion of impurities removed, and this is sometimes to such extent that the

units, which are also reduced to 1000. (See second table on next page).

Taking in all cases the percentage of the mixture of crystals and powder = 100, we obtain the following table, which will show more clearly still the effect of purifying:—

		Crystals and Powder Mixed.	Crystals.	Powder.
1. Original ..	100	55°0	43°3	
First treatment ..	100	77°0	22°6	
Second treatment..	100	91°2	8°9	
2. Original	100	86°2	13°2	
First treatment ..	100	91°8	7°9	
Second treatment..	100	95°9	4°6	

These tables again show the different effect upon the mixture of crystals and powder, and upon the crystals and powder separately, and, as I think, give a clear idea of the real working effect of the various treatments, such as has hitherto not been collected or published. I also think the above results will tend to prove the practical value of separating the crystals and powder, instead of merely estimating the mixture.

Some experiments made with the view of learning more

Effect of Purifying two Samples of Anthracene by two Consecutive Treatments.

			Crystals and Powder Mixed.		Crystals.		Powder.	
				270		277		
1. Original	.. .. .	17'8	266—268		9'8	273—275	7'7	not at 300
				277				270
First treatment	.. .. .	27'0	273—275		20'8	274—276	6'1	260—265
				280				
Second treatment	.. .. .	52'5	272—276		47'9	274—277	4'7	not at 300
				278				
2. Original	.. .. .	34'8	268—273		30'0	276—277	4'6	not at 300
				278				276
First treatment	.. .. .	41'7	276—277		38'3	276—277	3'3	264—270
				279				
Second treatment	.. .. .	56'3	275—277		53'9	274—277	2'6	not at 300

			Crystals and Powder Mixed.		Crystals.		Powder.	
No. 1	.. .. .	1000	17'8 = 17800 or 1000		9'8 = 9800 or 1000		7'7 = 7700 or 1000	
First treatment	.. .. .	440	27'0 = 11880 or 667		20'8 = 9152 or 934		6'1 = 3124 or 406	
Second treatment	.. .. .	190	52'5 = 9975 or 560		47'9 = 9101 or 929		4'7 = 893 or 116	
No. 2	.. .. .	1000	34'8 = 34800 or 1000		30'0 = 30000 or 1000		4'6 = 4600 or 1000	
First treatment	.. .. .	720	41'7 = 30024 or 863		38'3 = 27576 or 919		3'3 = 2376 or 515	
Second treatment	.. .. .	510	56'3 = 28713 or 831		53'9 = 27489 or 916		2'6 = 1326 or 287	

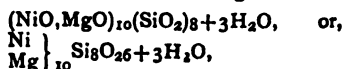
closely the nature of the powder may find their place here, although, as I have already stated, I have not yet come to a final conclusion on this point.

(To be continued.)

ON A NEW NICKEL MINERAL FROM
NEW CALEDONIA.

By P. G. W. TYPKE, F.C.S.

MR. A. LIVERSIDGE, Professor of Mineralogy, Sidney University, New South Wales, described, in 1874, in the *Journal of the Chemical Society* (New Series, vol. xii., p. 613) a new nickel mineral which he had obtained from New Caledonia, and to which he assigned the formula—



showing it to be principally a hydrated double silicate of nickel and magnesia.

Through the kindness of Mr. T. Loram, F.C.S., Mr. Valentin received a splendid specimen of the new nickel ore which had come into the London market, and at his instigation I submitted the ore to a fresh investigation. As the results which I obtained differ in many respects from those obtained by Professor Liversidge, I thought you might perhaps think them of sufficient interest to publish them in your valuable journal.

A glance at the ore showed that its composition was not uniform. The greater portion consisted of an emerald green, brittle substance, which could be easily scratched with the knife, and exhibited, when broken up, an uneven fracture.

This green mineral was coated in places where the water had acted upon it with a brown powdery substance, and exhibited layers or thin greenish white strata of disintegrated portions of the mineral, containing quartz crystals. Other portions of the ore showed dark brown to black with the lustre and appearance of radiated heavy spar, and contained much ferric hydrate.

A qualitative analysis of the several portions of the ore—the apple-green and the dark brown—showed that the latter differed from the former in containing more ferric hydrate and a little more alumina. Both contained principally silicic acid and nickel oxide, with little ferric oxide and alumina, and less even of lime and magnesia. The

green portion contained mere traces of ferric oxide and alumina, also mere traces only of lime and magnesia. The different portions of the ore were specially tested for carbonate, but traces only were found in each case, largest in the brown substance.

The hard and greenish white portion constituting the layers or strata already referred to, and resembling magnesian silicate, contained principally insoluble silica (quartz) with small quantities of the constituents of the soft green and brown parts of the mineral.

I more especially examined the green mineral, as the qualitative analysis had shown that it formed the more important constituent of the ore. It was amorphous and of uneven fracture. Its colour was of a bright apple-green to olive-green; streak light green; hardness about 3; sp. gr. = 2.468; lustre dull vitreous; heated in a closed tube it gave off water and darkened in colour; heated before the blowpipe flame it left a brown magnetic powder, and on platinum wire with borax gave the ordinary nickel bead.

Quantitative Analysis.

Determination of Water.—A carefully selected portion of the bright apple-green mineral was powdered in the agate mortar and dried at 100° C.

1. 4.8110 grms. lost 0.2120 grm. .. = 4.40 p. c. of OH₂
2. 0.6520 grm. of the mineral dried at 100° C. when ignited in a platinum crucible lost 0.0490 grm. .. = 7.51 " "

Total percentage of loss = 11.91 " "

The analysis of the other constituents was made with the portion of the mineral dried at 100° C.

Determination of Silica.—The substance was dissolved in dilute hydrochloric acid. The greater portion of the silica being left in the insoluble state (quartz), the whole was evaporated to dryness and ignited.

1. 1.4280 grm. of (dry) substance gave 0.7946 grm. of SiO₂ = 55.64 p. c. of silica
2. 0.8475 grm. of (dry) substance gave 0.4760 grm. of SiO₂ = 56.16 " "

Determination of Ferric Oxide and Alumina.—

1. 1.4280 grm. gave 0.0136 grm. of Fe₂O₃ and Al₂O₃ = 0.95 p. c.
2. 0.8475 grm. gave 0.0060 grm. of Fe₂O₃ and Al₂O₃ = 0.70 " "

No separation of the iron and alumina was attempted.

Determination of Nickel Oxide.—

1. 1.4280 grm. gave 0.5078 grm. ... = 35.56 p. c. of NiO
 2. 0.8475 " 0.3015 " ... = 35.57 " "

The nickel oxide when dissolved in hydrochloric acid and re-precipitated with KHO showed no diminution in weight.

Determination of Magnesia.—

1. Experiment lost.
 2. 0.8475 grm. gave 0.005 of $P_2O_7Mg_2$ = 0.18 p. c. of MgO

Mr. Liversidge ignited his mineral till "it ceased to diminish in weight," but does not appear to have observed that after ignition the nickel was no longer soluble either in hydrochloric acid or in *aqua regia*, whilst before ignition it dissolved freely in dilute hydrochloric acid, leaving insoluble white granular silica behind. The nickel silicate of the mineral being in the hydrated condition is converted by strong ignition in a platinum crucible into the insoluble anhydrous silicate.

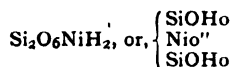
In order to ascertain whether nickel existed as hydrate in the mineral I boiled up a portion with ammoniac carbonate, filtered, and passed sulphuretted hydrogen through the filtrate. No nickel sulphide was obtained, showing that the whole of the nickel was combined with the silica.

Percentage composition of the
Mineral dried at 100° C.

	I.	II.	Mean.
Water lost on ignition	7.51	—	7.510
Silica	55.64	56.16	55.900
Nickel oxide	35.56	35.57	35.565
Alumina and ferric oxide .. .	0.95	0.70	0.825
Lime	mere traces		
Magnesia	—	0.18	0.180
			99.980

Water of hydration lost at 100° C. = 4.40 p. c.

From these figures the composition to be deduced for the apple-green nickel mineral is approximately that of a hydrated nickel disilicate of the formula:—



Another portion of the apple-green mineral picked from a different part of the ore yielded results which differed considerably from the figures obtained with the mineral just described. Unfortunately the determination of the nickel oxide was lost, and I was therefore unable to complete the analysis. Thus much, however, it would appear, may safely be deduced from the subjoined figures, that the proportions of silica and nickel oxide, as well as water of hydration, vary to some extent in the apple-green mineral.

Composition in 100 parts
of the dried (100° C.)
Mineral.

Water lost on ignition of the substance (dried at 100° C.) ..	6.55
Silica	66.97
Nickel oxide	lost
Alumina and ferric oxide .. .	0.18
Lime	trace
Magnesia	trace

A portion, 0.473 grm., of the mineral was boiled with pure sodic carbonate in a platinum dish, and the filtrate evaporated to dryness with hydrochloric acid, when it left 0.0225 of silica = 4.33 per cent of uncombined silica.

There is a considerable range left between Mr. Liversidge's 47.236 per cent of silica and my 66.97, or even 55.90 per cent of silica, as found in the two samples picked and selected with equal care; and we can therefore only come to one conclusion, viz., that the mineral is probably the result of the action of hydrated or soluble silicic acid upon some nickel compound, and that the pro-

portions of silicic and nickel oxide vary, and do not justify us in fixing upon a mineralogical formula, or making out a distinct species of a nickel mineral.

Royal College of Chemistry,
October 16, 1876.

ESTIMATION OF BARLEY IN OATMEAL.

By Messrs. PATTINSON and STEAD,
Analytical Chemists, Middlesborough-on-Tees.

As the practice of adulterating oatmeal with the less valuable barley-meal is much resorted to by millers and others, it becomes of the greatest importance to have some systematic method of analysis by which to determine the proportion of barley so introduced. We therefore beg to lay before your readers the following methods, practised by ourselves, which we find to give very good results.

In order to obtain an average sample from the parcel of meal received for analysis, the whole contents of the parcel are thoroughly mixed in a large porcelain mortar. A quarter of the meal mixed in this manner is now pounded to twice its original fineness, which is then spread evenly over the surface of a piece of paper. When this is done, 10 grms. (taken over the whole of the meal) are weighed off, pounded, and passed through a brass sieve containing thirty meshes to the linear inch. In order to expedite the pounding, which is a tedious process, after each pounding the oatmeal is transferred to the sieve, and is there rubbed with an india-rubber pestle, which has the effect of causing the fine meal to separate from the epidermis, to which it adheres very pertinaciously, and thus makes it difficult to pound. After the whole has passed through the sieve it is very well mixed up, and about 2 grms. placed in a 3-inch glass or porcelain mortar with sufficient milk-warm water to make a moderately thin paste. The mortar and contents are kept slightly warm during the pounding in order that the cellular matter may be softened, and the starch thus made easy to separate. The pestle is kept gently working for about five minutes, care being taken not to press too hard, for if too much pressure is applied the barley starch granules will be broken up. We find that the weight of the pestle itself is quite sufficient for the purpose. The sample after this treatment is ready for mounting. A small quantity of the paste is taken on the end of a glass rod, and is transferred to the slide of a microscope. A drop of water is allowed to fall on the paste, and a thin glass cover placed over the whole. Pressure is now applied to the cover, which is at the same time rubbed backward and forward. The excess of the substance in water is removed from time to time by means of blotting-paper.

The pressing and rubbing actions are continued till the outline of surrounding bodies can just be observed with the naked eye with an equal degree of distinctness through every part of the slide covered by the object. Great care is taken not to allow too much water to be under the cover, for when an excess of water is present the starch grains run together into groups, which at once renders the object useless. The slide prepared, it is now examined under the microscope, and the barley granules, in ten different fields, counted. Standard samples are now examined, one containing 5 and the other 10 per cent barley. These we always have ready for mounting. They are prepared by mixing 9.5 grms. and 9 grms. of pure oatmeal with 0.5 and 1 grm. barley respectively, and treating the mixtures in all respects as detailed above.

If the sampling and mounting has been properly executed, the number of barley granules found in ten different fields of the 10 per cent sample slide will be twice the number found in ten similar fields of the 5 per cent sample. This having been obtained, we have now only to calculate from the results obtained.

First divide the number of granules found in the 5 and 10 per cent standard slides by 5 and 10 respectively; this gives the number of barley grains corresponding to 1 per cent of barley. We have now only to divide the number of granules found in the sample slide by the figure obtained as above mentioned to arrive at the percentage of barley present.

We should here state that we always mount two slides, and take the average of the two results.

The following are the results obtained by testing mixtures of oat- and barley-meal, the composition of which was known, viz.:—

Barley Present in Oatmeal.	Granules in Ten Fields.	Barley Found.
1 per cent	8'0	1'00 per cent.
2 "	16'5	2'06 "
3 "	23'5	2'93 "
4 "	33'5	4'19 "
5 "	40'0	5'00 "
10 "	80'0	10'00 "
20 "	163'0	20'30 "
30 "	248'0	31'00 "

The great objection to microscope analysis has been due, first, to the great difficulty of obtaining a fair average sample in the minute amount mounted on the slide. Second, to the still greater difficulty of getting the same proportion of meal on comparative slides. It will be clear that the number of granules must depend on the amount of meal in any given area, and that unless the proportions are the same good results would be impossible. We, however, find that by the method of mixing with warm water, and stirring for a considerable time, a very thorough mixing is ensured, inasmuch that portions taken from different parts of the mixture when examined under the microscope give very concordant results. Also, that by making the comparative slides have an equal degree of transparency through those parts over which the meals are spread, the difficulty of obtaining similar amounts of meal on different slides is overcome, as we find that when the transparency is equal the amount of meal is also equal.

Second Method.

This method is based on the great differences in appearance and hardness of coarsely ground oat- and barley-meal. We proceed as follows, viz.:—After thoroughly mixing the sample, we sieve off the finer parts of the meal, and examine only the coarse portions, as we find that, as a rule, the coarse portions contain the same proportion of barley as the fine. 3 or 4 grms. are spread out on the surface of a piece of glazed paper, and with the aid of a pocket-lens and by pressing with the finger-nail, the harder barley particles are detected, and may be completely separated from the oats. It is only necessary to weigh the barley so obtained to arrive at the proportions in which it exists in the sample.

This is a very excellent method, and is always used by us in conjunction with the microscope method, with which it agrees very closely. It is best, however, not to depend on this method alone, as the sellers of oatmeal might take the precaution to mix what they sold with finely-ground barley, in which case the whole of the barley would pass off with the fine portion when being sieved, and more would therefore be found in the coarser part,

Sheep Husbandry in Georgia.—"A Manual of Sheep Husbandry in Georgia" has been prepared under the direction of the Commissioner of Agriculture of the State of Georgia. From it we learn that sheep-raising is more lucrative than cotton-growing, the average annual profit on capital invested in sheep being 63 per cent. The great drawback lies in the useless dogs with which we believe the United States are more infested than any other part of the world, and which in Georgia destroy 28,000 sheep yearly!

CORRESPONDENCE.

DYSODILE.

To the Editor of the Chemical News.

SIR,—I think you will find in Prof. Church's article on dysodile a mistake. In giving the results of his analysis he says—

"0'328 grm. gave 0'098 grm. Fe_2O_3 , or 28'88 p.c. Fe_2O_3 ." I think Prof. Church will find, if he will re-calculate the above data, that the percentage of Fe_2O_3 will be 29'87, or that, correctly stated, the above would be—
"0'328 grm. gave 0'098 grm. Fe_2O_3 , or 29'87 p.c. Fe_2O_3 ."
—I am, &c.,

R. P. DAVIES.

Littleborough, October 30, 1876.

ORGANIC AND MINERAL PHOSPHATES IN MANURES.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 154) you were good enough to insert a query for me asking for information respecting the estimation of mineral and organic phosphates in mixed manures. I had some slight hope of an answer, for I hear that there is an agricultural chemist who professes to do this. Perhaps, sir, by the insertion of this letter in your valuable journal we may derive information respecting the method of estimation, and test its accuracy.—I am, &c.,

E. CHRIS. POTTER.

3. Romney Terrace, Greenwich, S.E.,
October 28, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, du Dr. Quesneville,
October, 1876.

Chemical Force of Light.—An abstract of a work on this subject, recently published by M. E. Marchand. The chemical action of light is studied especially from a climatological point of view.

Spectrum Analysis.—A notice of Prof. Bunsen's recent paper inserted in *Poggendorff's Annalen*, vol. clv.

Theory of Spectral Rays.—M. G. Salet finds that many chemical elements, especially the non-metallic, have two spectra—one formed of lines, which is due to atoms, and one with bands, which pertain to molecules. Iodine in the state of vapour at the ordinary pressure gives an absorption-spectrum composed of channelled bands of the beautiful colour peculiar to this element, and which cannot be due to an unknown compound of iodine. But if an electric spark of high tension is caused to strike through the vapour there is obtained a totally different spectrum, composed of brilliant rays, the arrangement of which stands in no relation with that of the absorption-bands, and which do not coincide with those of any other known element. From analogous reasons M. Salet considers that it must be admitted that bromine, sulphur, &c., have each two distinct spectra. A spectrum with bands is also obtained with nitrogen, however it has been purified. The vapours of the alkaline metals yield also by absorption spectra quite similar to those of the non-metallic elements. The multiplicity of spectra appears, therefore, a general fact. The band-spectra, due to complex molecules, appear at temperatures where certain atomic groupings may still exist. The line-spectra appear when a very elevated temperature has disaggregated these combinations, and forced the atoms to arrange themselves in a more simple manner. It is to some extent a spectral allotropy.

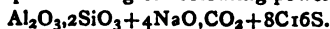
Observations on the Last Work of M. Pasteur on the Fermentation and Manufacture of Beer.—M. Charles Blondeau.—A lengthy dissertation, unfit for abstraction.

Historical and Chemical Survey of the Manufacture of Turkey-Red.—M. Theodor Chateau.—The conclusion of this treatise. The author in summing-up gives the following as his theory of the process of Turkey-red dyeing:—The oil employed brings with it a fatty acid, the oleic acid, or gives rise to the same or to a similar fatty acid, or to a mixture of fatty acids in which oleic acid predominates. In the process of aluming this fatty acid, simple or compound, combines with a certain quantity of alumina set at liberty in the operation, forming a fatty salt with an aluminous base, which may also be formed by double decomposition between alkaline fatty salts and salts of alumina. This fatty acid at the same time forms a kind of combination with albuminoid matter, whether the sort of vegetable albumen found in the emulsive oils (*huiles tournantes*), or with the animal albuminoid matters of yolk of egg, blood, gall, when these are employed, or with those of the dung of cows, sheep, or goats. This threefold compound of fatty acid, alumina, and albuminoid matter has not the stability of a definite compound, for neutral liquids like acetone, oils of turpentine and petroleum, and sulphide of carbon split it up, or rather divide it into several parts, some soluble in these media, and the others insoluble or merely viscid. This triple compound does not combine intimately with the fibre of the cotton, since the above-mentioned neutral solvents remove it, proving that it is merely deposited on the surface, or at any rate penetrates but to a small depth, a fact which constitutes one of the physical characters of the brightness of Turkey-red. This triple compound unites, or rather is dyed, on contact with the colouring matter of madder without forming any intimate combination with the fibre of the cotton, such as takes place in the operations of dyeing upon tissues prepared with ordinary mordants. The lake thus formed on the outer surface of the cotton may be brightened by the ordinary methods of "clearing."

Manufacture of Ultramarine.—C. Furstenau.—Only two silicates of alumina are serviceable in the manufacture of ultramarine, $2\text{Al}_2\text{O}_3 \cdot 3\text{SiO}_2$ and $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$. These silicates yield colours having different properties according as they are treated with the bisulphide or pentasulphide of sodium, thus:—(1.) $2\text{Al}_2\text{O}_3 \cdot 3\text{SiO}_2$ treated with Na_2S_2 give a light blue product of feeble colouring power. (2.) $2\text{Al}_2\text{O}_3 \cdot 3\text{SiO}_2$ with Na_2S_3 gives a pure deep blue of great colouring power. These two colours do not contain alum. (3.) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ treated with Na_2S_2 gives a reddish light product not very pure. (4.) $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ treated with Na_2S_3 gives a deep violet-blue of great colouring power. China clays in which the alumina and silica are found in other proportions than those indicated above give mixtures of different ultramarines. For a pure blue the following mixture may be taken:—



For reddish products of great colouring power—



Salicylic Acid and its Applications.—Dr. F. von Heyden.—A very long paper, not suitable for abstraction.

Certain Derivatives of Dimethyl-Protocatechuic Acid and of Vanillic Acid.—MM. F. Tiemann and Kaeta Oukimori Matsumoto.—Taken from the *Ber. der Deut. Chem. Gesellschaft*. The authors have given vanillic acid the more formidable name of mono-methyl-protocatechuic acid.

Coniferyl and Vanillin.—F. Tiemann.

Sulphur in Lighting-Gas.—M. A. Vérigo.—Already noticed.

Litigation on the Use of Aniline-Black in America.—The action brought by M. J. J. Müller Pack, purchaser of the patent-rights of the late Mr. J. Lightfoot, against the

Merrimack Manufacturing Company has been decided in his favour.

MISCELLANEOUS.

The Research Fund of the Chemical Society.—A sum of £1000 has been voted to the Chemical Society by the Goldsmith's Company, in aid of the fund for the promotion of original research.

New Scholarship in Chemistry at Owens College.—The sum of £700 has been presented to Owens College, Manchester, by Mrs. Grace Calvert, for the foundation of a Scholarship in Chemistry of the annual value of £25, in memory of her late husband, Dr. Grace Calvert, F.R.S.

Lead Poisoning.—In a late number of *The Lancet* a somewhat singular case of cumulative lead-poisoning is reported, which tends to show that early rising has its pains and penalties as well as its profits and pleasures. A cab-washer who was in the habit of drinking deeply during the day, and of sleeping in an omnibus until the time came for him to wash forty cabs, was brought into St. Mary's Hospital, in February, 1875, suffering from phthisis and delirium tremens. He recovered from the latter complaint and got better of the former, but it was found that he had completely lost the use of his upper extremities, while his voice was reduced to the merest whisper. On being questioned he stated that, as he usually finished his work just as the public-houses opened, he always had the very first glass of beer or gin that was served in the morning; that is to say, the liquor which had remained all night in the drawpipe in contact with the lead. His gums showed the well-known blue line indicative of lead poisoning, and other confirmatory symptoms existed which need not be detailed here. His urine gave 1-3400th of a grain of lead per fluid ounce, and some of the gin which he drank every morning having been procured and tested gave 1-430th of a grain per fluid ounce. From the beginning of June to the beginning of December he was treated with iodide of potassium in large doses, and was galvanised and faradised daily, but all to no purpose. Mr. S. J. Knott, M.R.C.S., the medical superintendent of galvanism at St. Mary's Hospital, suggested that a thorough trial of galvanic baths should be made on the patient. Accordingly, on December 4th, he was placed in a warm bath, and the water charged with twenty-eight cells of a voltaic battery. At first the current was passed from the positive pole, placed at the nape of the neck, to the negative, which was placed at the feet. After ten minutes the negative pole was moved along his legs and arms for twenty minutes more. The treatment was continued daily, and at the end of a fortnight he was so much better as to be able to raise his arms fairly, and flex them pretty well. From this time he continued to mend, the baths being still kept up three times a week, and finally returned to his work in February. The fourth bath was acidulated and tested by Dr. Handfield Jones, who found well-marked traces of lead in it, which were absent in the water supplied to the bath. If lead can be thus eliminated from the body by the electric current, why not arsenic, mercury, and silver? In ordinary cases of lead colic and dropped wrists the electric bath has proved efficacious in a few days without any medicine. If this method of administering electricity be equally efficacious in other cases of plumbism as in those treated by Mr. Knott, medicine will have to thank physical science for putting into her hands an additional weapon for counter-acting human disorders.

TO CORRESPONDENTS.

W. Wallace.—The tables will be inserted in an early number.

J. B. Lindsay.—Reece's machine is a good one.

ERRATUM.—On page 185, col. 1, line 30 from top, for "2000 grammes" read 2000 grains.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 885.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.
(Continued from p. 188.)

Chlorine, Bromine, Iodine, and Fluorine.
By Dr. E. MYLIUS, of Ludwigshafen.

THE arrangements for the ventilation of the bromine works are peculiarly interesting. The critical moment is when the manganese liquid is run out of the stone tanks, since it throws off vapours of chlorine and bromine in abundance. Yet the operation is performed without the least inconvenience to the workman. Along the series of stills there runs a channel of brickwork, through which a powerful current of air is drawn by the great chimney of the works in a direction opposite to that in which the liquid runs off. The channel is situated so that the vent holes of the stills open into it. In front of every still there is introduced in the roof of the channel a damper which is opened when the plug of the vent hole is about to be knocked out. The draught is so powerful that the workmen are not in the slightest degree incommoded by the vapours evolved from the stream of solution of manganese. The workshops smell distinctly of bromine, but the odour is far fainter than that which is experienced in our scientific laboratories during the bromation of organic substances.

As has been already remarked, crude bromine always contains a little chlorine, even when, according to the Stassfurt practice, the Woolf bottle is allowed to become slightly warm towards the end of the operation, so as to drive the volatile chloride of bromine over into the iron-tunnings. A rectification is therefore requisite. This takes place in glass retorts containing about 15 litres, the necks being cemented into receivers bedded in cold water. Each retort is set in a separate sand-bath, so that if one happens to burst—and such misfortunes cannot be avoided—the injury may be limited as much as possible. Only a slight aqueous fraction contains chlorine; it is withrawn and returned to the stone stills. The rectification lasts about twenty-four hours. The atmosphere in the rectifying-house is more offensive than that in the still-houses, since all currents of air must be carefully avoided. The workmen, however, require to enter this room from time to time. Moreover there are especial arrangements which render it possible to decant the bromine both out of the Woolf's bottles into the retorts, and from the receivers into the vessels used for transport without any annoyance from the vapours abundantly evolved during these operations. The decantation is performed in wooden chests, through which a violent current of air is drawn by the great chimney. The workmen soon acquire such dexterity and accuracy in these manipulations that they are content to cover the respiratory organs with a wet cloth, and disdain to make use of the ventilating arrangements placed at their disposal.

(At Stassfurt bromine is sent off in strong glass bottles holding 2½ kilos. The well-ground stoppers are sealed with shellac, luted with clay, and tied up with parchment paper. Four or twelve such bottles are packed in a chest.—A. W. H.)

Iodine.—The rapid extension in the demand of the splendid violet, blue, and green coal-tar colours, which are prepared by means of the iodides of the hydrocarbons has in the last few years occasioned a notable increase in the consumption of iodine. The production, from very simple reasons, could not keep pace with the growing consumption, which of course led to a considerable increase in the commercial value of a body relatively of such rare occurrence in nature. Its price has been further increased by the circumstance that the seaweed ashes of England and France (Kelp, Varec) have become less remunerative to the producers. Formerly these weed ashes served to supply a considerable part of the demand for the salts of potash, but since the utilisation of the well-known "Abraum salts" of Stassfurt the extraction of potash salts from seaweed ashes has become so unremunerative that the loss in the returns of the kelp trade has to be balanced by a rise in the price of the iodine.*

The hope of a fall in the commercial value of iodine in consequence of its extraction from the mother-liquors of nitrate of soda has not been fulfilled. The production of iodine from this source has increased but little, and some nitre refineries, which had commenced the utilisation of the iodiferous mother-liquors, have again abandoned the attempt.† On the other hand, in tinctorial industry attempts have been made to dispense with the use of iodine. Although the attempt to employ bromine in place of iodine (see "Bromine") has failed, other methods have recently been discovered for producing the most magnificent violet, blue, and green tar colours without the aid of iodine. Nevertheless the price has not been essentially reduced since the methods for preparing the dyes without iodine have not by any means been adopted in all establishments.

In addition to the tinctorial arts iodine is employed in scientific chemistry, where its importance is incalculable and also in photography and in medicine.

(To be continued.)

ON SOME EFFECTS PRODUCED BY THE ADDITION OF SULPHATE OF ALUMINA IN THE TREATMENT OF SEWAGE.

By A. McDONALD GRAHAM, F.C.S.

IN your review of a recent publication, "Causeries Scientific" (CHEM. NEWS, vol. xxxiv., p. 69), the reader's attention is directed to the following paragraph:—"Sulphate of alumina, on which so much dependence has been placed, certainly clarifies the sewage. The gelatinous alumina agglutinates the solid substances, but the dissolved matters, mineral and organic, are nowise retained." The last sentence, which is a very faithful translation from the original, contains a statement which is neither new nor true, and the language employed reminds one of the great Dr. Johnson's way of disposing of the swallows in autumn. "Numbers of them," says the learned Doctor, "conglobulate together, and precipitate themselves into the water." That the application of sulphate of alumina to the sewage removes nothing but the suspended matter has been asserted over and over again by persons who, from their position, would have been supposed to have known better; and perhaps it would not be amiss, now that the

* According to a letter from Mr. E. Stanford, of Glasgow, to Prof. A. W. Hofmann, a ton of chloride of potassium in 1863 cost £21 13s.; in the ten following years on an average £15 15s.; and is now worth only £7 10s. The price of iodine has risen in a corresponding degree; in 1863 an ounce of iodine cost 4½d.; on the average of the following ten years 7d.; whilst it is now worth 2s. 3d. per ounce.

† According to private communications from M. E. Schering the production of iodine from the mother-liquors of soda salt-petre is again on the increase. A Peruvian nitre refinery, which separates the iodine as cuprous iodide by means of bisulphite of soda and sulphate of copper, produced, in 1873, 15,000 kilos. cuprous iodide, and is about to increase its production to 50,000 kilos., corresponding to 30,000 kilos. of iodine.

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

public attention is turned to the sewage question, to recapitulate some of the substances carried down by alumina. And, first, the phosphoric acid is removed from the sewage, and by its removal the effluent water is found to be less liable to putrefaction, while the manure derived from the sewage must be to some extent improved, although I am aware the value of phosphate of alumina as a manure has been called in question.

Secondly, albuminoid substances are carried down by the alumina. I think this is proved by the general behaviour of bodies of this nature with alumina, and also by the percentage of nitrogen found in the precipitated mud, which is higher than would be produced by the suspended matter alone. The albuminoids are found to undergo rapid decomposition and to give forth offensive odours, and their removal tends to keep the effluent water sweet.

Thirdly, the fatty acids of soap dissolved in the sewage are carried down by the alumina—a point which, I think, has been hitherto somewhat overlooked. It is true that there is some loss in the subsequent drying of the mud, but a considerable portion of these fatty bodies is obstinately retained by the alumina, as may be proved by experiment. I am inclined to think that the beneficial effects produced by the sewage manure on the land is in a great measure due to the large quantity of fatty matters precipitated by the alumina. Farmers have assured me that they found the manure of considerable value, and I think the effect of the fatty matters on the soil has not up to this moment been sufficiently considered.

An enterprising firm proposed some time ago to manufacture artificial butter from the Thames mud, and I have myself made a very fair cake of soap from the fatty acids extracted from the sewage mud. The association of ideas, however, is not agreeable, although I do not think the most fastidious person would object to burn a candle which had been derived from the sewage.

In some of the Towns of Yorkshire—Leeds, for instance—I have been told that a large quantity of soap is found in the sewage, not because the Yorkshire folk are more frequent in their ablutions than other people, but from the fact that soap is extensively used in the manufacturing processes, and it is possible that some portion might be recovered from the sewage. If so, the question of "How are you off for soap?" when addressed to corporations and local boards, would assume a new significance, as its recovery from the sewage would form some set-off to the expense of purification.

Wellfield Villa, Turnchapel, Plymouth,
October 17, 1876.

ANALYSIS OF AN IRON DEPOSIT.

By G. PATERSON.

THE deposit of which an analysis is given below is from the surface of the Lochar Moss, a very extensive peat moss now in part under cultivation in the south of Scotland, bordering on the Solway Firth. It is found in large quantity in the open ditches and drains; in the latter it is formed in such considerable quantity that the tiles in time become entirely choked up, so that they have to be raised and cleaned. In the ditches it forms, below the running water, a layer of thick red-brown slime, often 10 to 12 inches in depth; and as these ditches have to be cleaned out at least once in the twelve months, and sometimes even more frequently, the amount of the deposit—which, by the way, is commonly known in the district as "iron ore"—thrown up on the banks in course of time is very large. Perfectly clear water taken as it runs from the drains reacts strongly for proto-salts of iron, becomes cloudy after standing a few hours, and deposits a red-brown sediment.

The sample taken for analysis was collected from an open drain, and was quite free from any foreign matter;

the deposit was allowed to settle, the water decanted off, and the residual slimy matter dried at 100° C. before analysis.

Examined under the microscope the deposit proves to consist almost entirely of the Conservoid Algæ, *Didyma helix ferruginea*, together with a small amount of amorphous ferric precipitate.

	Per cent.
Organic matter and water..	50·74
Ferric oxide	43·29
Ferrous oxide	3·58
Lime	0·51
Magnesia	0·10
Sulphuric anhydride	1·29
Phosphoric anhydride..	0·18
Sulphur	0·15
Soluble silica	0·31
Sand	0·65

100·80

Laboratory, Wallasey Ore Yard,
Birkenhead.

COUNTRY LABORATORY APPARATUS.

NO. I. FLOWER-POT GAS FURNACE, CRUCIBLE JACKET, &C.
NO. II. ROUGH AND READY METHOD OF ESTIMATING
VOLATILE MATTER AND COKE IN COAL.

By EDWARD T. HARDMAN, F.C.S.,
H.M. Geological Survey, Ireland.

NO. I. THE following short description of an extremely effective, cheap, and cleanly substitute for crucible jackets, &c., may be useful, especially to those who, like myself, have occasion to shift their quarters often, and are obliged to work with a necessarily limited laboratory accommodation.

The ordinary crucible jacket being made of sheet-iron has in reality but one use—to protect the flame from currents of air. The small concentration of heat which it affords may be regarded as nearly *nil*, since, from the nature of the material and its thinness, radiation takes place very freely.

Another drawback it has, is that it soon becomes rusty or coated with scale. It is not only dirty to handle therefore, but also presents the inconvenience of dropping some of its scale into the crucible if not carefully manipulated. Then it is an awkward thing to pack, taking up a good deal of space, rusting everything it comes in contact with, and behaving generally in a disagreeable manner; while, as it is not to be obtained in country towns, it may not be left behind.

Now an ordinary earthenware flower-pot answers the purpose in every respect. It is the proper shape, and being made of a non-conducting material it in a great measure prevents loss of heat from the burner. It is extremely cleanly to use, and last but not least, it can be procured in every town or village at the small cost of one halfpenny or so; so that there is no necessity to cumber oneself with it when moving.

The bottom of the flower-pot has a circular hole. This serves for the introduction of the Bunsen burner. As the supply of air would be insufficient otherwise it will be necessary to enlarge the opening. This can be easily done with a knife, and I find it best to cut the aperture nearly in the form of a cross, and not too large. One or two trials will give the happy medium. A current of air is then obtained which not only steadies the flame, but acts in some degree as a blast. The flower-pot may be supported in the ring of a retort stand in the usual way. The chimney is a second flower-pot inverted. To support it the handiest way will be to make three S hooks of stout wire, and having passed the narrow end of the pot upward through the ring, fix the rim within the hooks caught on the ring, as in fig. 1.

It will be found convenient to devote a small retort stand permanently to the purpose. The whole arrangement is shown in fig. 2.

This will be very handy, as the upper part can be raised to any desired height, regulating the heat and draught; or can be shifted from side to side, whenever it is desirable to inspect the progress of the operation going on.

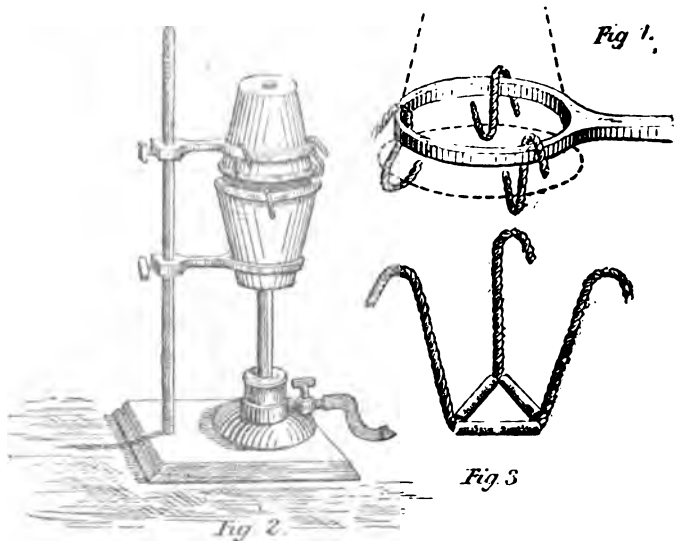
The apparatus acts admirably as a small gas furnace for crucible operations, such as the fusion of silicates with carbonate of soda—as in the analyses of rocks; while for simple ignition of precipitates it renders the flame of a common glass spirit-lamp most effective. The size of the flower-pot required will, of course, depend on that of the crucible and of the burner used. I find the smallest size, $3\frac{1}{2}$ inches high and about 3 inches diameter at top (internal), most generally useful.

The support for the crucible may be either a triangle of wire covered with pipe shank, the end of the wire being bent upwards and formed into hooks so as to hang on the edge of the flower-pot (fig. 3), or three pipe-covered wires suspended in the position of the ribs of a crucible jacket. The former is necessary for small crucibles.

The flower-pot also makes an excellent lamp screen, for steadying and concentrating the flame under evaporating basins, &c.; of course a sufficient interval must be kept between the pot and the basin, else the light will be extinguished.

whole is exposed to strong heat in the furnace for an hour or two, when the volatile matter is driven off. After cooling the difference of weight against that determined before ignition gives the volatile matter. Having occasion to determine the volatile matter of a coal, and not having at hand the elaborate arrangements referred to above, I bethought me of the schoolboy's method of manufacturing coal-gas. The retort he uses is a common clay tobacco pipe. A piece of coal is put in, the top is luted with clay, and the pipe is inserted in the fire-grate with the stem projecting. Presently a dense smoke issues from it, and a match being applied a veritable gas light—but not "16-candle"—results. On opening the luting a piece of coke is found in the pipe. I suppose most of us have performed this experiment. It is obvious that it is only necessary to weigh the pipe and contents before and after the operation, and we have the volatile matter and coke determined.

The larger the pipe the better. Those I have used hold about 100 grains of coal broken small but not powdered. The pipe is weighed, then filled with the coal and weighed again to obtain weight of coal. Then inside the top is fitted a circular piece of writing-paper, the use of which is to prevent any of the luting getting down among the coal, where it could not be removed, and would falsify the last weighing. The top is luted with moist fireclay, or with the cement used for luting the covers of gas retorts,



A small flower-pot with wire gauze tied over the top is a very effective low temperature lamp when the gas is lighted below the gauze. If the gas is lighted above the gauze we have a capital argand lamp giving a large clear blue flame. In the latter case a common burner can be used, a consideration when Bunsen's are all temporarily occupied or not available.

After a time the pots become cracked from the heat, but as they are easily replaced this does not matter, and even when cracked they will often hold out for a considerable time. Fireclay flower-pots made rather thick would, however, afford a really good cheap and portable furnace.

It has just occurred to me that by placing the flower-pot inside another just large enough to encase it, loss of heat by radiation would be effectually checked.

No. II. The usual method of estimating the volatile matter in coals implies a laboratory on rather an extensive scale. A furnace with a good draught is required. The coal is placed in a large porcelain crucible, which is then put into a Hessian crucible, and covered with powdered charcoal to exclude air. The cover being then put on, the

and the pipe, being placed in a common coal fire or in a gas furnace—that described above (No. I.) answers very well—from ten to twenty minutes completes the operation. When cool the luting is carefully taken off and the charred paper removed. The pipe and contents being then weighed, the loss gives the volatile matter, the same weighing, of course, determining the coke. If a very exact determination is required, a quantity of the coal may be broken small, well mixed together, and four pipes filled as above. They can all be ignited together in a fire, and weighed very quickly. The results will be found to agree very closely.

The figures thus obtained do not differ from those given by the same coal assayed on the laboratory plan to a greater amount than will be found to occur between two experiments made on the same coal in the latter way. And the tobacco pipe process has the great advantage of being very expeditiously performed—the whole experiment including weighings not occupying more than thirty minutes—and with very simple apparatus.

Kilkenny, October 9, 1876.

ON THE ACTION OF DIFFERENT FATTY OILS UPON METALLIC COPPER.*

By WILLIAM THOMSON, F.R.S.E., F.C.S.

(Continued from p. 177.)

SERIES I.—SHORT STRIPS OF COPPER COVERED COMPLETELY BY THE OILS.
(Commenced October 1, 1875. Examined August 9, 1876.)

Name of Oil.	Appearance of oil when examined.	Appearance of strip of copper.	Relative amounts of copper contained in solution in the oil.	Relative amounts of the copper salt dissolved by water.	Relative amounts of acidity given to water.
1. <i>Mesina Olive Oil.</i>	Yellowish colour and limpid.	Thickly coated with salt of copper; green incrustation.	Trace.	Trace.	Trace.
2. <i>Olive Oil.</i>	Ditto.	Ditto.	Trace.	Trace.	Trace.
3. <i>Rape Oil.</i>	The oil is of a brownish-yellow colour.	The slip of copper is covered with a slight dark coloured deposit.	Trace.	Trace.	Trace.
4. <i>Refined Rape Oil.</i>	The colour has changed to a deep green.	The slip is quite bright.	Very large.	Large.	Rather large.
5. <i>Cotton Seed Oil.</i>	The oil has acquired a very slight greenish hue, and has formed a ring of icicle forms all round the glass at the surface of the oil; these forms are of coagulated oil.	The plate or slip is covered all over with thin patches of green copper salt and dark coloured deposit, mixed with tufts of solid fatty matter, which has also deposited on the copper which lies at the bottom of the oil.	Very small.	Trace.	Absent.
6. <i>Pale Cotton Seed Oil.</i>	This has changed in every respect exactly like 5, with the exception that the icicle forms are not so thick.	The copper slip is covered slightly with a dark deposit.	Small.	Trace.	Very small
7. <i>Linseed Oil.</i>	A tough skin covers the surface of the oil, which has assumed a deep green colour.	The copper slip appears quite bright.	Very large.	Very large.	Large.
8. <i>Oil of Almonds.</i>	The oil has acquired a slight greenish hue.	The slip is covered with a very slight dark coloured deposit.	Rather large.	Moderate.	Small.
9. <i>Sperm Oil.</i>	The oil is of a dark brownish colour.	The slip of copper is quite bright.	Extremely large.	Very large.	Large.
10. <i>Raw Cod-liver Oil.</i>	The oil has become as thick as jelly, and is of a dark amber colour.	Ditto.	Large.	Large.	Large.
11. <i>Pale Seal Oil.</i>	The oil has become of a thick syrupy consistency, of the same colour as 10, but lighter.	Ditto.	Moderate.	Small.	Small.
12. <i>Seal Oil.</i>	The oil has the same consistency as 11, but is slightly darker in colour.	Ditto.	Moderate.	Small.	Small.
13. <i>Lard Oil.</i>	The oil has become slightly greenish in colour.	The slip is covered with a greenish-black deposit.	Large.	Small.	Trace.
14. <i>Foreign Neatsfoot Oil.</i>	The oil is of a yellowish colour; white flakes and pellets of solid fats have settled to the bottom, and fill it to about one-third the volume of the oil.	The slip of copper is thickly covered with a green deposit of copper salt.	Trace.	Absent.	Rather large.
15. <i>Tallow Oil.</i>	Has become solid, with a honeycombed appearance, produced by irregular, cell-like deposits of solid fat mixed with the liquid oil.	The slip is covered with a green deposit of copper salt.	Absent.	Absent.	Rather large.
16. <i>Neatsfoot Oil.</i>	A white deposit of solid fat has settled to the bottom; the supernatant oil is almost colourless and quite limpid.	The slip is covered with a thick green deposit.	Absent.	Absent.	Very large.

* Read before the British Association, Glasgow Meeting (Section B.).

Name of oil.	Appearance of oil when examined.	Appearance of strip of copper.	Relative amounts of copper contained in solution in the oil.	Relative amounts of the copper salt dissolved by water.	Relative amounts of acidity given to water.
17. <i>Cotton-seed Oil.</i>	The oil is almost colourless, but has a greenish hue; a ring of coagulated, oil-like icicles are attached to the glass at the surface of the oil.	A dark coloured deposit covers the surface of the copper.	Small.	Trace.	Large.
18. <i>Palm Oil.</i>	No change appears to have taken place in the oil.	The slip is covered with a bright green deposit of copper salt; at some parts, however, the copper appears quite bright.	Very small.	Very small.	Large.
19. <i>Whale Oil.</i>	The surface of the oil is covered with a thick, hard skin, but the oil is quite fluid underneath.	The copper slip is quite bright.	Trace.	Trace.	Large.
20. <i>Cod Oil.</i>	The oil is of a dark amber colour, and is covered with a soft, elastic skin, and has the consistency of jelly.	Ditto.	Very small.	Trace.	Very large.
21. <i>Shark Oil.</i>	The oil is of a reddish brown colour and quite liquid.	Ditto.	Moderate.	Trace.	Large.
22. <i>Newfoundland Cod Oil.</i>	The oil has a syrupy consistency and dark amber colour.	Ditto.	Very large.	Small.	Very large.
23. <i>Common Seal Oil.</i>	The oil has a syrupy consistency and a dark bright amber colour.	The slip of copper is quite bright.	Very large.	Small.	Very large.
24. <i>East Indian Fish Oil.</i>	The oil has a light yellowish-brown colour.	Ditto.	Trace.	Absent.	Very large.
25. <i>Heavy Mineral Oil.</i>	The oil has a dark reddish-yellow appearance.	The copper slip is covered with a very slight greyish deposit.	Absent.	Absent.	Absent.
26. <i>Mineral Oil.</i>	The oil has a brownish-red colour.	The slip is covered with a slight dark grey deposit.	Absent.	Absent.	Absent.

(To be continued.)

A PROCESS FOR OBTAINING ALKALI FROM SEAWEED.

At the Chemical Works at Aalborg, in Jutland, Denmark, where about 30 tons of alkali are made per week by the ammonia process, Mr. Thowald Schmidt, the Director of the Manufactory, proposes to work, in conjunction with this process, a method devised by himself of treating seaweed so as to obtain iodine, potash salts, and other marketable products therefrom. In Denmark a very heavy duty is levied on the importation of common salt, whilst enormous quantities of seaweed rich in iodine and potash can be obtained at small cost in the neighbourhood of the works. Mr. Schmidt's process is as follows:—After the seaweed is dried and burnt a concentrated solution of the ash is made and added to the liquor containing chlorides of sodium and calcium, left after the ammonia has been recovered in the ammonia-soda process by boiling with lime. The sulphates of potash, soda, and magnesia contained in the ash of the seaweed are thereby decomposed, and hydrated sulphate of lime and hydrated magnesia are precipitated in a form which may be available for paper-making as "pearl-hardening." The last traces of sulphates are got rid of by adding a small quantity of solution of chloride of barium. To the clear solution nitrate of lead is now added until all the iodine is precipitated as iodide of lead, which is then separated by filtration and treated for the production of iodine or iodides. After filtration the liquid is boiled, nitrate of soda is added to convert the chloride of potassium present into nitrate of potash. The latter is separated by crystallisation. There remains a solution of common salt containing traces of ammonia from the previous soda operation and a trace of chloride of potassium. This solution is again treated by the ordinary ammonia-soda process for the production of bicarbonate of soda and white alkali.

ON ANTHRACENE TESTING.

By DR. FREDERICK VERSMANN.

(Concluded from page 193).

I HAVE stated at the beginning of this article that the failure with sulphuric acid induced me to look for another test and led me to the separation of the products of oxidation into crystals and powder. It was natural, therefore, that I should apply the sulphuric acid not only to the mixture but also to the two separate products, and the results thus obtained point with almost absolute certainty to the conclusion that the powder is practically useless, and is, in fact, no anthraquinone at all.

I have tried the usual sulphuric acid and also fuming or Nordhausen acid, the use of which naturally suggested itself from its application in the alizarine manufacture. The results obtained do not sensibly vary, but I have adopted the last acid as the strongest and most active, and I may state that in speaking of sulphuric acid I always mean fuming or Nordhausen acid.

The samples treated, a small proportion of which only are given in the first table, are so different that it is necessary to record the separate results; but I am anxious to condense the matter as much as possible, and I have therefore in the following table reduced to one-half the number of experiments of the first table. The treatment with acid was carried out in the following manner:—

The products of oxidation were for ten minutes heated in a small porcelain basin or in a large watch-glass with ten times their weight of acid at a temperature not exceeding 110° C.; they were then allowed to stand for twelve hours, largely diluted with water and brought on a double filter, well washed, dried, and weighed. In the following table the first line of each number gives the

percentage and melting-point before, the second line that after treatment with sulphuric acid:—

Action of Sulphuric Acid.

No.	Crystals and Powder Mixed.	Crystals.	Powder.
	276	278	280
6.	15.2 274—275	10.2 274—276	4.6 270—275
	278	279	
	14.4 276—277	9.8 277—278	4.2 not at 300
	278	277	278
8.	16.2 274—276	11.6 273—275	5.2 266—272
	276	275	
	14.6 274—275	10.8 275—275	3.7 not at 300
	270	277	
9.	17.8 266—268	9.8 273—275	7.7 not at 300
	272	277	
	12.2 272—272	9.6 275—276	3.0 not at 300
	279	277	
0.	18.2 271—275	14.2 275—276	3.9 not at 300
	279	278	
	16.9 273—276	13.9 274—276	3.2 not at 300
	278	277	
11.	20.2 274—276	16.3 273—275	3.7 not at 300
	280	278	
	19.8 276—278	16.0 274—276	2.4 not at 300
	277	281	276
13.	22.0 273—275	18.3 273—277	4.0 266—272
	276	279	
	21.3 276—276	18.2 277—277	2.6 not at 300
	270	276	260
14.	23.3 266—268	15.1 272—274	8.0 256—258
	270	274	
	21.8 270—270	14.6 274—274	6.1 not at 300
	280	280	271
16.	26.4 274—277	22.1 276—278	4.2 261—266
	276	280	278
	24.6 276—276	22.1 276—278	1.2 278—278
	277	278	270
17.	27.0 273—275	20.8 274—276	6.1 260—265
	276	276	
	24.4 276—276	20.0 276—276	3.1 not at 300
	278	278	
20.	34.8 268—273	30.0 276—277	4.6 not at 300
	278	278	
	31.2 276—277	29.7 276—277	4.2 not at 300
	271	275	262
23.	39.9 267—269	34.0 273—274	5.8 258—260
	273	275	
	39.3 273—273	33.6 273—274	5.2 not at 300
	278	278	276
24.	41.7 276—277	38.3 276—277	3.3 264—270
	279	278	
	39.8 279—279	37.8 276—277	0.4 not at 300
	268	275	246
26.	49.5 268—268	40.9 271—273	8.7 250—248
	270	274	
	48.4 270—270	40.4 272—273	8.1 not at 300
	280	280	
27.	52.5 272—276	47.9 274—277	4.7 not at 300
	280	280	
	49.7 278—279	47.2 278—279	4.2 not at 300
	279	280	
28.	56.3 275—277	53.9 274—277	2.6 not at 300
	278	278	
	55.3 278—278	52.9 278—278	0.7 not at 300

The action is perfectly uniform with samples of the most varying percentages. The mixture of crystals and

powder, originally of a more or less light yellow colour, was in all cases darkened by separated carbon; the loss in percentage is mostly considerable; the melting- and solidifying-points are slightly improved; and, taking this series by itself, the results might well be estimated as pure quinone. But this idea will soon prove most erroneous.

The crystals are very little affected both in percentage and melting-point; they retain their original pure colour; no carbon is separated; and they are undoubtedly pure quinone both before and after treatment with acid.

But the powder shows a totally different character. In most cases the percentage is largely reduced, while the melting-point, which before could only be noted in nine out of fifteen cases, has altogether disappeared. The expression "not at 300" means, in most cases, the substance slightly softens and becomes charred at that temperature. In most cases the residue from the treatment with acid was simply carbon, and no crystals could be detected even under the microscope; in a few instances some well-defined crystals were observed, but the relative quantity was insignificantly small, and had no effect upon the melting-point; No. 16 forms the only real exception, and I look upon the 1.2 per cent of powder as good quinone.

I look upon this result with the powder as of considerable importance, because it clearly shows that by the separation of crystals and powder the actual truth has been more nearly approached than before, and also because it affords a pretty accurate insight into the nature of different samples.

As an illustration I will take one sample, No. 9 in first table, which is of a very exceptional character, for which reason I have also submitted it to the process of purification by two consecutive treatments, the results of which are given in Nos. 17 and 27. This sample represents, as I know, a lot of anthracene obtained by the re-distillation of anthracene oil, *i.e.*, oil from which the anthracene has been separated. It is of course well known that large quantities of such anthracene are made and sold simply because no ready means were known to prove its more than doubtful quality. By the usual test this sample would appear to be of a fair average quality, but the splitting up into crystals and powder is much more striking than the action of sulphuric acid. But the last table shows the action of the acid upon the products of usual quinone test not to give anything like accurate results; the melting-point of the mixture is misleading, and the powder in the mixture is not so well acted upon by the acid as in the separate form.

This leads me to a short consideration of Messrs. Meister, Lucius, and Brünig's "new and improved method," which, I think, has but little chance of being adopted, and I find my opinion shared by several people here whose judgment must be of considerable weight. I consider this method as not practical, because it is too delicate for practical working, and consequently the results will not be correct. I think it scarcely possible without loss to transfer the solution of quinone in hot acid from one basin to another considering the small quantities in hand, and I look upon this operation as an unnecessary addition to the already large number of manipulations—more than twenty from beginning to end—as the solution may be heated and cooled in the same basin. This is a minor objection, but I take it as practically impossible to separate the quinone from carbon by heating the dish, *i.e.*, to completely volatilise the first without burning a particle of the last or without the last retaining any of the first.

Above all this method is based upon the assumption that the acid destroys everything except quinone, which it certainly does not. I have made several experiments with samples of commercial quinone, dissolving them in acid, treating them like anthracene samples, *i.e.*, boiling them with chromic acid in the usual manner, also separating the product into crystals and powder, and finally treating these with sulphuric acid.

A detailed account of these experiments I must reserve for a future occasion, but I will state the results arrived at clearly bring out the fact that sulphuric acid does not destroy all impurities.

Before concluding I wish to say a few words on the melting- and solidifying-points of pure quinone. I have long been under the impression that the pale yellow colour of quinone was due to some trace of impurities, and that perfectly pure quinone was quite white. I have purified a quantity by repeated re-crystallisations from petroleum spirit and sulphuric acid alternately, but the final result is not absolutely colourless, it shows the faintest trace of very light yellow.

The melting-point of quinone is given by different observers as 273, 275, and 276. I find it even a little higher; the very pure sample melts and solidifies at fully 277, which degree I am inclined to look upon as the current one.

In conclusion I may remark that to fix the relative commercial value of per cent unit by my test it may perhaps be desirable at first to combine with it the usual test, thus giving as the result of the analysis, percentage and melting-point of crystals and powder mixed, and of crystals and powder separate. A very short time will suffice to bring out the relative value of per cent.

35, Whitecross Place, Wilson Street,
Finsbury, E.C.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 2nd, 1876.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the minutes of the previous meeting had been read and confirmed, and the presents announced, the following names were read for the first time:—Messrs. W. C. Davis, J. Clark, T. Tyrer, F. H. Marshall, T. G. Charlesworth, J. Wood, Griffith Jones, B.A., J. Falconer King, and C. C. Capel. For the third time:—Messrs. Thomas H. Johnson, Otto Hehner, G. C. Thomson, H. A. Bernays, W. J. Fuller, and Gustav Auerbach, who were ballotted for and duly elected.

The PRESIDENT then announced that the Goldsmiths' Company had generously contributed £1000 towards the Society's Research Fund, started some time since by Mr. Longstaff.

Mr. LUPTON read the first paper, "*On the Oxides of Potassium*." After mentioning the experiments of Davy, Gay-Lussac, Thénard, and others, he described the method by which he had obtained some new oxides of potassium: this consisted in passing air, and in some cases nitrous oxide, over metallic potassium gently heated to a known temperature in a glass flask. In this way he had, by stopping the action at certain stages, obtained three new oxides, K_2O_3 , K_6O_4 , and K_4O_3 ,—but could find no evidence of the existence of an oxide of the composition K_2O .

The PRESIDENT having thanked the author, a communication "*On certain Bismuth Compounds*" (Part III.), by Mr. M. M. P. MUIR, was read by the SECRETARY. In it the author describes two new bismuth chromates, namely, $3\text{Br}_2\text{O}_3 \cdot 7\text{CrO}_3$ and $5\text{Bi}_2\text{O}_3 \cdot 11\text{CrO}_3 \cdot 6\text{H}_2\text{O}$, the former being of a light orange colour and the latter brick-red. The action of bromine on hot bismuthous oxide was found to give an oxybromide of the formula $\text{Bi}_{11}\text{Br}_7\text{O}_{13}$. On passing dry ammonia over the bismuth oxybromides, $\text{Bi}_3\text{Br}_{16}\text{O}_{15}$ and BiOBr , metallic bismuth was obtained. The author has also succeeded in preparing a hypobismuthic hydrate, $\text{Bi}_2\text{O}_4 \cdot \text{H}_2\text{O}$, by suspending the oxide in potassic hydrate solution and passing in chlorine at 100° until the oxide had acquired a chocolate-brown colour.

The next paper was "*On Phospho- and Arseno-Cyanogen*," by Mr. W. R. HODGKINSON. As chloroform is converted into formonitrile or hydrocyanic acid by the action of ammonia, it was hoped that an analogous compound, containing phosphorus or arsenic in place of nitrogen, would be obtained on substituting PH_3 or AsH_3 for ammonia. A variety of experiments were tried by acting on chloroform and iodoform with nascent phosphine in different ways, but the results were very unsatisfactory. On the other hand, a solution of iodoform in anhydrous alcohol or ether, when treated with arsine, yielded a reddish brown amorphous precipitate, containing carbon, hydrogen, iodine, and arsenic, and which is insoluble in most menstrua. This substance is still under investigation.

"*A Secondary Oxidised Product formed during the Reduction of Stannic Ethide to Stannous Ethide*," by W. R. HODGKINSON and G. C. MATTHEWS. On treating an aqueous solution of stannous diethyl chloride or bromide with zinc, it is reduced to stannous ethide, whilst a small quantity of a yellowish green amorphous solid is produced by a secondary process of oxidation. After being repeatedly washed with ether and with strong hydrochloric acid, to remove adhering stannous ethide and metallic zinc, &c., it was thoroughly washed, and dried *in vacuo* over sulphuric acid. The results of the analyses were found to agree with the formula $\text{C}_5\text{H}_{15}\text{SnCO}_2$. This substance does not combine with acids. It fuses and volatilises slightly at 100° .

The thanks of the Society having been given to the authors of these papers, a preliminary notice by Messrs. W. R. HODGKINSON and H. C. SORBY was read, on "*Pigmentum nigrum, the Black Colouring-matter contained in Hair and Feathers*." When perfectly white hair or feathers are heated gently with dilute sulphuric acid for some time they completely dissolve, but if black or brown feathers or hair are thus treated an amorphous black residue is obtained. This substance, which exists only in very small quantity in the blackest feathers, may be conveniently prepared from rooks' feathers (which yield about one per cent) which have been separated from the central rib, and thoroughly cleaned from waxy and fatty matter by treatment with alcoholic ammonia. On digesting them with successive quantities of dilute sulphuric acid for several days, until the acid ceases to be coloured by red or brown soluble colouring matters, a black residue is obtained, which, after being thoroughly washed with dilute hydrochloric acid at 80°C ., and then with water, is dried, and the last trace of fatty matter finally removed by treatment with boiling alcohol and ether. On analysis it gives numbers agreeing very well with the formula $\text{C}_{18}\text{H}_{16}\text{N}_2\text{O}_8$. It is not acted on by dilute acids or alkalis, but nitric acid slowly oxidises it. It forms new compounds by the action of bromine, one of which is soluble in water, and gives a characteristic absorption spectrum.

In reply to a question from the President, Mr. SORBY said he had regarded the subject of the colouring-matter of hair and feathers more from a biological than from a chemical point of view. Having found that a black residue was left on heating feathers with the dilute acid, Mr. Hodgkinson had undertaken to investigate chemically the nature of the substance. The black pigment was found in black, brown, and dark red hair, but in the latter it was associated with a brown pigment soluble in dilute sulphuric acid. In very bright red hair he had also found a pink colouring-matter. The feathers of birds were of two kinds, namely, those which contained the *pigmentum nigrum*—including the iridescent feathers, such as those of the peacock, which are really black—and another class of feathers, like those in the crest of the crowned crane, which are not iridescent, but contain various coloured pigments. He considered it very important, from a physiological point of view, that this matter should be more fully investigated. With regard to the pigment of the negro's skin, he had not examined it, but had no doubt

that it would prove to be identical with that found in the hair.

Mr. SORBY exhibited a specimen of *pigmentum nigrum*, and also specimens illustrating the colours obtained with this pigment and others soluble in the dilute acid.

Prof. CHURCH said his attention had been entirely directed to the feathers in twelve species of turaco, in which the red parts of the feathers were coloured by turacin. This differs in an important point from the *pigmentum nigrum*, in that its ash consists wholly of oxide of copper. The amount of copper present in turacin is considerably larger than he had formerly stated; this was owing to the fact that when turacin is distilled a red coloured substance passes over which contains copper. This, unlike turacin, is insoluble in ammonia, but soluble in ether.

The PRESIDENT, having thanked the authors for their extremely interesting communication, adjourned the meeting until Thursday, November 16th, when the following papers will be read:—"On Barwood," by the late Dr. Anderson; "On Potassium Trioxide," by G. S. Johnson; "On the Coal-Gas of the Metropolis," by J. S. D. Humpidge; "On Calcium Sulphate," by J. B. Hannay.

PHYSICAL SOCIETY.

November 4th, 1876.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

The following candidates were elected Members of the Society:—Warren de la Rue, D.C.L., F.R.S., and W. H. Preece.

Dr. GUTHRIE read two letters which he had received from Dr. Forel, in continuation of a communication he made to the Society on the 27th of May last, in reference to the "Seiches" or periodic oscillations which take place in the Swiss lakes, and on which he has recently made an elaborate series of observations. Since his communication he has found, in a pamphlet by Dr. J. R. Mérian, published in 1828, a formula strictly applicable to the phenomena under consideration. If t be the duration of half an oscillation, h the depth of the lake, and l its length:—

$$t = \sqrt{\frac{\pi l}{g}} \left\{ \frac{e^{\frac{\pi h}{l}} + e^{-\frac{\pi h}{l}}}{e^{\frac{\pi h}{l}} - e^{-\frac{\pi h}{l}}} \right\} \frac{1}{2}$$

Considering that probably this formula will be applicable to lakes of irregular depth if h be the mean depth, he has applied it to several, and the following are some of his results:—In the case of transverse seiches on Lake Lemman the formula gives 216 metres as a mean depth, and 334 metres is the greatest known depth. With a longitudinal oscillation the mean depth is found to be 130 metres. In the case of Lake Wallenstadt, the formula having shown the mean depth to be somewhat greater than the generally accepted greatest depth, Prof. Forel took a number of fresh soundings, and found a great basin of comparatively even bottom, and of such a depth as to render probable the mean depth given by the formula.

Mr. O. J. LODGE suggested that the formula would be rendered more simple by using the hyperbolic function. It would then become—

$$t = \pi \sqrt{\frac{l}{g}} \coth \frac{1}{2} \frac{\pi h}{l}$$

Mr. Lodge also exhibited the curve which this equation represents.

Dr. STONE exhibited some diffraction gratings on glass and metal, ruled for him by Mr. W. Clark, of Windsor Terrace, Lower Norwood. The majority of them were close spirals, about 1000 to the inch, which, when held between the eye and a distant lime-light, exhibited circular spectra of great brilliancy. The slight difference between the spiral and true circles appeared to exercise no appreciable effect on the result. The metal gratings were of linear form, 1000 lines to the inch, intended for use by reflection in a spectroscopic. The spectra thus obtained were of much greater brilliancy than those ordinarily obtained by refraction, and presented obvious advantages for examining the ultra-violet rays. He explained the mechanical difficulties which had been surmounted in their manufacture, together with the manner in which the diamond cutters are prepared. The metals hitherto employed, namely, cast-steel and German silver, are objectionable, and Dr. Stone proposes, on the suggestion of Prof. McLeod, to employ speculum metal, and will report the result of the experiments more fully at a subsequent meeting.

Dr. GUTHRIE then briefly described some experiments which he had made to determine the effect of a crystalloid on a colloid when in the presence of water. Mr. Graham, in his classical researches, made numerous experiments with a salt on one side of a colloid membrane and water on the other, and Dr. Guthrie thought it might be well to determine what action, if any, takes place when a salt is added to a solution of a colloid such as size. Two or three lumps of rock-salt were added to a jelly of size, and the whole hermetically sealed in a glass tube. The colloid parted with its water readily, a saturated solution of the salt was obtained, and the size became perfectly white and opaque, having undergone a structural change. Experiments were also made, employing a more hygrometric salt, such as chloride of calcium.

Mr. W. C. ROBERTS pointed out that a jelly containing 5 per cent of silicic acid readily parts with water to sulphuric acid, and dries into a hard glass-like hydrate of silica. He asked whether this might be considered as analogous to the action of salt on size, or whether the strong affinity between the acid and water removed it to another class of action.

Dr. GUTHRIE thought it might be possible to establish the existence of a point at which the jelly did not give up its water to the hygrometric substance. He also pointed out the analogy between a jelly and a mass of small bags filled with liquid.

NOTICES OF BOOKS.

Water Analysis: a Practical Treatise on the Examination of Potable Water. By J. ALFRED WANKLYN and ERNEST THEOPHON CHAPMAN. Fourth Edition, rewritten by J. ALFRED WANKLYN, M.R.C.S., &c. London: Trübner and Co.

WE are by no means surprised that a new edition of this work has become necessary. The increasing attention paid to public health and the growing conviction of the importance of a pure water supply, must lead to a higher appreciation of the analytical process first made known in its pages—a process which may truly be said to have rendered the sanitary examination of water possible, which, if not absolutely perfect, is by far the most satisfactory we yet possess, and which has been adopted by competent and disinterested judges in most parts of the civilised world.

The present edition is by no means a mere reprint of those which have appeared before. The body of the work is now divided into three sections; the first part being devoted to "water analysis for general sanitary purposes." If the question is merely whether the water of a

given well can be safely used for domestic purposes, Mr. Wanklyn considers that a reply may be obtained from the results of the determination of total solids, of chlorine, of free and albuminoid ammonia, and of poisonous metals, if present. Instructions for these determinations are given in successive chapters and require no further comment, since this portion of the work has not undergone any essential modification.

The second part of the book "is more especially designed for those who make analytical chemistry a profession," and contains minute directions for the execution of a complete mineral analysis of a water-residue. These instructions will be of great service to the chemist who is consulted on the selection of a water supply for any town. This part of the work has been rearranged, modified, and considerably extended. We have, first, a chapter, not found in the earlier editions, on the specific gravity of natural waters. Then follows the determination of the insoluble, and of the soluble solids in the water residue, and of the alkalinity. Here we find an account of an improvement for the details of which the author declares himself indebted to a private communication from Dr. Mohr, and which will be of great use in all cases where very small amounts of alkali in the state of carbonate have to be determined volumetrically. Mr. Wanklyn remarks that the alkalinity of water expressed as grains of carbonate of lime per gallon is almost identical with the insoluble solids.

The section on "Hardness" is extended by the addition of a method for the titration of magnesia in drinking waters, the operation being capable of completion within a quarter of an hour. Next follows a chapter on the "General Quantitative Analysis of the Water Residue," under which head we find directions for the determination of sulphates, nitrates, iodates, &c., and phosphates, which latter, however, the author considers can rarely be present except in infinitesimal proportions.

In stating the results of an analysis, Mr. Wanklyn disapproves of the method of "stating the quantity of each metal and each acid-radical in a given volume of water," which, he considers, "has the fatal property of masking and concealing most fundamental facts that the analysis should disclose." He holds that "water residues may be looked upon as impure carbonate of lime or impure chloride of sodium." The chapter on the "purification of water" contains much novel and interesting matter. The decomposition, or otherwise the removal, of such bodies as quinine, morphia, and strychnine by passage in solution through charcoal must lead to further results. The chapters on "Gases and Vapours Dissolved by Water" and on "Urine and Sewage" are substantially the same as in the last edition.

The third part of the work is composed of "Examples of Complete Mineral Analyses," and deals with the water supplies of London, Manchester, Sunderland, Croydon, and Bonn, and with the waters of the Rhine and the Nile.

The appendix contains a republication of the original memoirs of Messrs. Wanklyn, Chapman, and Smith, on the action of oxidising agents upon organic substances in alkaline solution, and a reprint of documents bearing on the controversy between the author and Dr. Frankland as to the merits of their respective processes for the analysis of water. To pronounce upon this portion of the book would be an invidious task. We do not like prolonged controversies, and we find that a man with a grievance, however good his case, often comes to be regarded as a bore. But if an author is attacked, and if his reply is excluded from the journal where the attack is published, he can scarcely be blamed for defending himself wherever it is practicable. Nothing, we think, is more certain to find its level than an analytical method.

In fine, we must express our opinion that this edition of Mr. Wanklyn's work will meet with even higher and wider approval than its predecessors in accordance with its greatly increased value.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 15, October 9, 1876.

Absorption of Free Nitrogen by the Proximate Principles of Vegetables under the Influence of Atmospheric Electricity.—M. Berthelot.—According to experiments which have been made free nitrogen is directly absorbed at the ordinary temperature by organic matters under the influence of the electric effluve (*Comptes Rendus*, lxxxii., p. 1283). This absorption takes place both with pure dry nitrogen and hydrocarbons, a case in which oxygen is totally excluded, and with moist cellulose and dextrin (p. 1357). The author's experiments demonstrate the influence of a natural cause, hitherto scarcely suspected, and nevertheless of great importance for vegetation. When the effects of atmospheric electricity have been taken into consideration, its luminous and violent manifestations, such as thunder and lightning, have been chiefly regarded. Upon whatsoever hypothesis the formation of nitric and nitrous acids or of nitrate of ammonia have been exclusively studied. But the author's experiments show a new and hitherto unknown action, which works unceasingly under the most serene sky, and which determines a direct fixation of nitrogen in the principles of the tissues of plants.

On Capillary Affinity.—M. E. Chevreul.—The author refers to experiments on this subject described in his earlier writings. He advises all chemists who desire to know the degree of certainty which ought to be attributed to analytical methods to examine both their reagents and the bodies that have been separated with the spectroscope.

Action of Boric Acid and of the Alkaline Borates upon Plants.—M. E. Peligot.—The author finds that boric acid and borates of potassa and soda have a destructive action upon vegetables. He therefore doubts the propriety of their use for the preservation of articles of food, and suggests that their action upon animals should be carefully investigated by a commission nominated by the Academy of Sciences.

Reciprocal Action of Oxalic Acid and the Monoatomic Alcohols.—A. Cahours and E. Demarcay.—Not suitable for abstraction.

Determination of Free Nitrogen in Organic Substances: Chemical Composition of certain Gun-cottons (Abel's Compressed Gun-cotton, Collodion-Paper, and Collodion).—P. Champion and H. Pellet.—The authors have applied to the determination of nitrogen the methods of Pelouze or of Schloesing with an important modification. When nitro compounds are not capable of being carried along by the vapour of water they employ the arrangement which has been suggested by M. F. Jean (*Bull. de la Soc. Chim.*, June, 1876, p. 13). The authors consider compressed gun-cotton, prepared by Abel's method, not as tri-nitro-cellulose, $C_{12}H_7O_3NO_3$, but as penta-nitro-cellulose, $C_{24}H_{15}O_{15}NO_5$. They have found the composition of a Russian sample of collodion obtained from M. Carotte. A sample of pyroxyllised paper only contained two equivalents of nitric acid.

Limits within which the Explosion of Fire-Damp is Possible, and on New Properties of Palladium.—M. J. J. Coquillion.—It is difficult to obtain a strong explosion with air and fire-damp on working upon small quantities of gas, as is done in laboratories. 1 part of fire-damp with 6 of air, and 16 of air with 1 of fire-damp, are the two extreme limits. Palladium wire, even if heated to white-redness, does not fire the most explosive mixtures.

No. 16, October 16, 1876.

The session of the Academy was opened by a discourse pronounced by M. Dumas, on occasion of the death of M. C. Sainte-Claire Deville, the well-known mineralogist.

Relation of the Two Specific Heats of a Gas.—M. C. Simon.—It is concluded that in simple gases the physical molecules remain sensibly invariable in form and dimensions so long as no electric or chemical phenomenon is produced.

Etching Action Produced upon Different Metals by the Acids.—MM. Tréve and Durassier.—It is known that the action of acids upon metals gives rise to various figures which have been sometimes considered as calculated to throw a light upon the internal structure of the metal. We have had occasion to make certain observations, which seem to show that in the conditions in which we operated the figures are connected, not with the internal structure, but with the external action exerted by the bubbles of gases disengaged during the reaction of the acids. The authors give an illustration representing two horse-shoe magnets which have been plunged into acids, and which are grooved in a regular design, not capable of being made intelligible by a mere description.

Compound of Chloral and of Acetic Chloride.—MM. J. Curie and A. Millet.—The result is a liquid heavier than and insoluble in water, soluble in alcohol, ether, and glacial acetic acid, boiling without decomposition between 186° and 188° , and containing 62 per cent of chlorine.

Sulpho-antimoniuret of Lead found at Arnsberg, in Westphalia.—M. F. Pisani.—This mineral is not a plagionite, as might at first sight be assumed, but a true heteromorphite. Its hardness is 2.5, and its specific gravity 5.59 to 5.73. Its composition is—

Sulphur	19.90
Antimony	31.20
Lead	47.86
Zinc	0.60

99.56

Origin of Eruptive Rocks, Vitreous and Crystalline.

—A. M. Lévy.—An examination of the microscopic structure of two eruptive rocks, which, in the opinion of the author, may throw some light on the origin of vitreous and crystalline rocks.

Justus Liebig's Annalen der Chemie,
Band 183, Heft 1.

Compounds of Phthalic Acid with the Phenols.—

Adolf Beyer.—The first part of a long but interesting memoir. The author treats of fluorescein, its history, preparation, properties, and salts; of diacetyl-fluorescein, dibenzoyl-fluorescein, monoethyl-fluorescein, diethyl-fluorescein, and chloride of fluorescein. He shows that fluorescein can take up a molecule of water without decomposition, and that two molecules of resorcin can be successively withdrawn from it. He then proceeds to the reduction-product of fluorescein, known as fluoresein, and examines the behaviour of the former body with different reagents, and its substitution-products, including dinitro-fluorescein, diacetyl-dinitro-fluorescein, the hydrate of dinitro-fluorescein, and tetra-nitro-fluorescein. He then treats of the action of bromine upon fluorescein, and the production of mono-brom-fluorescein, dibrom-fluorescein, diacetyl-dibrom-fluorescein, and tetra-brom-fluorescein (better known as eosin), the salts of eosin, and erythrin with its salts. The second chapter of the treatise is devoted to orcinphthalein, and is taken from an inaugural dissertation by E. Fischer.

On Boron.—Dr. W. Hampe.—The author shows that the supposed crystalline boron obtained by Wöhler and Sainte-Claire Deville by fusing aluminium with amorphous boron or with boracic acid is not pure boron, but compounds. To the black crystals he assigns the formula

AlB_{12} , and to the yellow kind $C_2Al_3B_8$. The determinations of the specific heat of boron are hence no longer trustworthy, with the exception of those of Kopp, executed with amorphous boron, the number found being 0.254. This multiplied into the atomic weight of boron, 11, gives 2.798, a product half as large as that of most other elements. All attempts to obtain pure crystalline boron have been unsuccessful. The author is engaged with an investigation of the purity of amorphous boron as prepared by the method previously employed.

Contributions to the Theory of Luminous Flames.

Dr. Karl Heumann.—In this part of his treatise the author arrives at important results, both theoretical and practical. He shows that the carbon in the flame exists as a solid body, and not, as Frankland assumes, in the state of vapour. He finds that gas-jets of steatite are decidedly preferable to those of iron, since they consume less gas for an equal strength of light. Metallic jets, in general, notably enfeeble the light. He refers to the result obtained by the Commission of the English Board of Trade who reported, in opposition to the view of Vogel, that a refrigeration of the gas does not decrease the amount of light, and considers that they must have experimented with a kind of gas poor in hydrocarbons capable of condensation. On the contrary, he finds that if the jet and the outflowing current of gas are both strongly heated the luminous effect is increased to an extraordinary degree.

Presence of Guanin in the Urine of Swine.—

Domenico Pecile.—The swine in question had been fed upon bran alone, and was evidently suffering from gout. The author is endeavouring to ascertain the presence or absence of guanin in the urine of healthy swine.

MISCELLANEOUS.

University of London.—The following is a list of the candidates who have passed the recent B.Sc. examinations:—*Pass List.*—First Division. John Henry Best, University College; Thomas Capper, Trinity College, Cambridge; John Kent Crow, Owens College; William Hewitt, Royal School of Mines; William Wansbrough Jones, Magdalen College, Oxford; John Frederic Main, Trinity College, Cambridge; Hermann Ludwig Theodor Sack, B.A., private study; Ambrose Robinson Willis, Royal School of Mines. Second Division. Reginald Hargreaves Bulley, Owens College; William Fisher, B.A., King's College; Cecil Reeves Harrison, University College; John Stephenson Jellie, private study; Archibald Prentice Ledward, Owens College; Archibald McAlpine, Royal College of Science, Dublin; George William Mackie, B.A., private study; Henry Major, B.A., private study; James Monckman, Yorkshire College of Science; James Isaac Paddle, B.A., University College; Walter Pearce, St. Mary's Hospital and Royal School of Mines; Bernard Joseph Snell, B.A., New College; Edward Holdsworth Sugden, B.A., Owens and Headingley Colleges; Albert Edward Tovey, private study.

Science Scholarships.—In the *Dublin Daily Express*, Professor Galloway calls attention to a paper on "Technical Education," read at a recent meeting of the Iron and Steel Institute by the secretary, Mr. Jones. In this paper the author said that the Commissioners of the International Exhibition of 1851 have still a surplus of £186,000, and that it had been proposed to expend £100,000 of this on a scientific library and on science scholarships to be attached to the Science School at South Kensington. He proposed that it should be distributed amongst the different science colleges and institutions in England. Professor Galloway asks Irish members of Parliament to get this distribution extended to Ireland. He hopes, at least, that a chemical scholarship will be obtained for the College of Science, Dub lin

The students at this college have, he says, never yet been equalled at the London University examinations by the students from any of the other colleges in the United Kingdom. They have hitherto invariably obtained honours in chemistry. In 1870 a University Exhibition was established. It was not awarded in the first two years. The College of Science gained it both in the fifth and seventh years. No other institution has taken it twice, and it has only been gained once by three others—viz., Guy's Hospital, University College, and the School of Mines. The competition for honours is very severe. Sixty students went in this, the seventh, year of the exhibition, and only ten passed, and two of such were students, and the only students, from the College of Science.

MEETINGS FOR THE WEEK.

THURSDAY, Nov. 16th.—Chemical, 8. "On Barwood," by the late Dr. Anderson. "On Potassium Tri-iodide," by G. S. Johnstone. "On the Coal-Gas of the Metropolis," by J. S. O. Humphreys. "On Calcium Sulphate," by J. B. Hannay.

TO CORRESPONDENTS.

A. Duggan.—Consult the "Student's Number" of the CHEMICAL NEWS, published September 15th last.
Novacastrian.—We have only seen the advertisements and prospectus.

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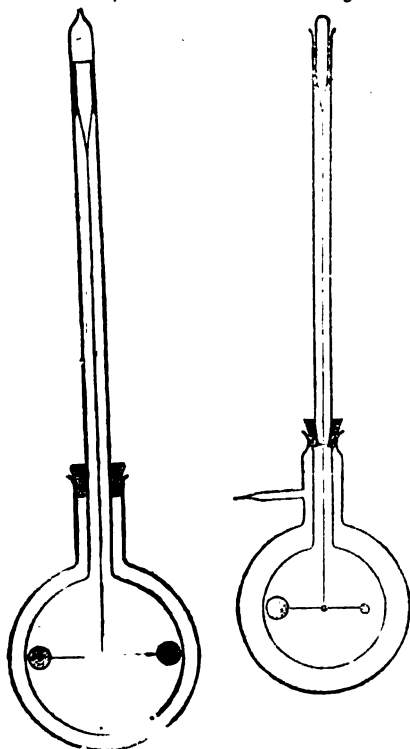
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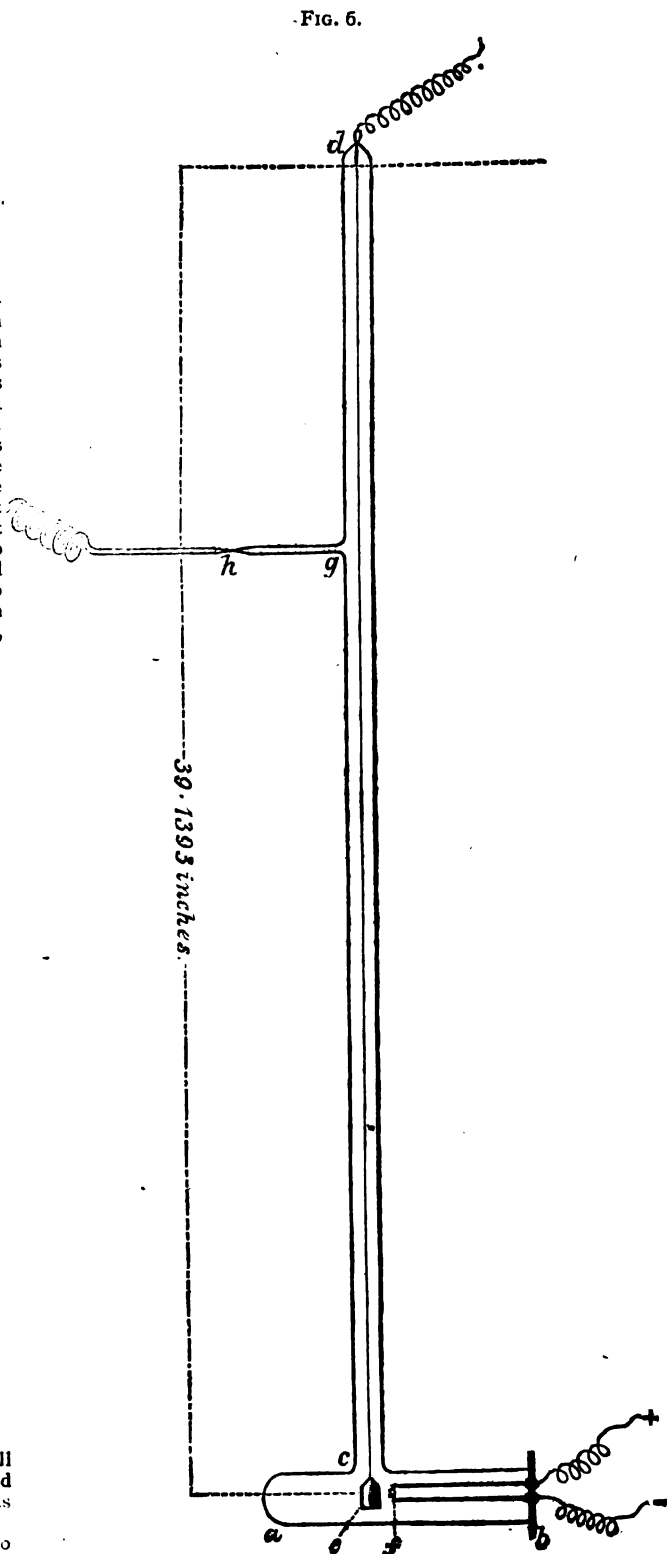
VOL. XXXIV. No. 886.

(Continued from p. 176).

FIG. 5.



98. Another form of apparatus is shown in fig. 5. Two



bulbs were blown one in the other, and they were fused together at the necks; to the neck a small tube was fused for connecting with the Sprengel pump. The space between the two bulbs was then perfectly exhausted, and the small tube sealed up. I thus possessed what might be called a spherical shell of vacuum surrounding a bulb open to the air. In this inner bulb was suspended a pith ball on the end of a glass arm balanced by a knob of glass on to the other end, the suspending fibre being protected by a glass tube fitting into the neck of the inner bulb with a cork. It was found that heat applied to any part of the outer bulb passed across the vacuum, and attracted the pith ball (suspended in air). The spherical shell of vacuum across which the heat passed, therefore, produced no change of action, but simply behaved like an extra thick glass bulb. This experiment bears upon the speculation in par. 81 of my former paper on this subject.

99. Having succeeded in proving the fact of repulsion resulting from radiation, I was desirous of getting some quantitative estimations of the forces under examination. A pendulum-apparatus was constructed as shown in fig. 6. A wide glass tube (*a b*) has fused to it a narrower tube (*c d*), about 40 inches long; *e* is a turned mass of magnesium, weighing 42 grains, suspended by a very fine platinum wire, the distance between the point of suspension and the centre of gravity of the magnesium bob being 39.139 inches, so that it forms a seconds' pendulum; *f* is a spiral made of platinum plate, fastened to two stout copper wires which pass through the thick plate of glass *b*, and thence pass to a contact-key and a battery. The plate *b* is cemented (83) to the end of the tube *a b*, which is ground flat. *g* is an arm fused into the upright tube for the purpose of connecting it to the glass spiral of the pump; it is contracted at *h* for convenience of sealing off. The fine platinum wire is fastened at its upper end to a thick wire which is sealed into the glass, and passes through to the outside for electrical purposes (120). The distance between the pendulum bob and the spiral is 7 millims. To ignite the spiral the current from two Grove's cells was used; this brought it to a bright red heat in air, and to a white heat in vacuum.

Three feet from the pendulum a telescope was firmly clamped to the bench; it was furnished with a micrometer eyepiece, with movable spider threads and graduated circle. The edge of the magnesium bob was brought into the same focus as the traversing cross wire. Observations were taken in the following manner:—The observer at the telescope brought the cross wire to zero, and then adjusted it to coincide with the edge of the pendulum bob. An assistant, guided by a seconds' watch, pressed the contact-key down for one second, then broke contact for a second, next made contact for the third second, and so on, alternately making and breaking contact for either 10, 20, or 40 seconds, counting the seconds aloud. At each second the swing of the pendulum increased; and the milled head of the micrometer was kept turning so as to let the cross wire keep up to the furthest point to which the pendulum vibrated. At the end of the experiment the position of the cross wire was taken and its distance from zero recorded.

(To be continued.)

ON ANTHRACENE PRODUCTION.

By Dr. FREDERICK VERSMANN.

My investigation on anthracene testing, published in the last three numbers of the CHEMICAL NEWS, has brought me many inquiries and communications, which induce me to supplement this purely scientific investigation and its practical application by some remarks on the commercial aspect of anthracene manufacture generally; and I do so simply because I think my information may enable me, perhaps, to throw some light upon this important question, and also because a crisis in this manufacture seems

to become inevitable, and that in no distant time, the serious consequences of which it may well be worth while to weigh and to consider beforehand.

We all recollect the profound sensation created by the grand discovery of artificial alizarine and its manufacture on the large scale, which last commenced only five or six years ago. In recalling the sanguine expectations raised by this new industry, its present dismal position appears scarcely credible, and yet the fact stands out only too clearly that no other branch of chemical industry, inaugurated under such bright auspices, has in its results fallen so short of just expectations,—nay, I might also say, has become so disastrous to nearly all persons who remained engaged in its pursuit. True the first pioneers—those who were actually at work while the first excitement was at its height—were wise enough to sell their fortunes at prices which brought them large profits. First among these stood Messrs. Gessert Brothers, who sold their at that time flourishing concern to a Company, and the English alizarine manufacture, which has since changed hands a second time.

Putting aside a very few German alizarine makers, who profess to work at a profit, we have at present a disheartening list of many large undertakings who are hopelessly insolvent, or at least uncomfortably near to it.

In Germany all public companies are very properly compelled by law to publish their annual balance-sheet in at least three newspapers, and such document—published only on the 10th inst., in the *Cologne Gazette*—by the "Chemische Industrie Aktien Gesellschaft zu Elberfeld," formerly Gessert Brothers, tells its own tale in a few figures. This official document informs the shareholders that the loss of the twelve months' working, ending at Midsummer last, amounts to £40,000; and as this dismal statement is merely a repetition of previous equally unsatisfactory balance-sheets, there seems to be little doubt that at next month's general meeting the Company will be wound up, and that very likely the whole capital—amounting to some £180,000—will be lost.

Again, a private firm, Messrs. Schöneberg and Hufschmidt, also of Elberfeld, recently suspended payment, with liabilities estimated at £90,000 and assets £60,000, or a deficit of £30,000.

The "Stueckfaberei Gesellschaft" and the "Elberfeld Aniline and Alizarine Gesellschaft," also joint-stock companies, are defunct for some time, their capital having been entirely lost.

Plain facts like these—and the list might easily be made more complete—may well lead to an inquiry into the cause of such calamity. It may be justly argued that bad management, want of skill or proper knowledge in the manufacture, and, above all, the general depression in all trades, especially in the cotton trade and everything depending upon it, have a great deal to do with the non-success of so many undertakings; but I believe the real and primary cause to be the most unhealthy state of the anthracene manufacture.

The fact is the production of anthracene far exceeds its demand, which, suddenly sprung up some years ago, tempted many distillers to manufacture an article of a very doubtful quality; competition unreasonably ran up the price of tar, and the principal benefit was pocketed by the gas companies, and by them alone.

I am induced to give a few figures, which will clearly show this disproportion, and which I feel sure will be very near to the actual truth, because I have every reason to depend upon their correctness.

Up to the end of 1877 there will be produced in England alone, including present stock, at least 1400 tons of pure or 100 per cent anthracene. The requirements of all the alizarine works at present do not exceed 2 tons a day, or 600 tons a year, of pure anthracene. The next year is expected to see a considerable increase, but if with present low prices we even double the quantity—making it 1200 tons—England alone will produce 200 tons of pure anthracene more than required.

But it must not be forgotten that the Continent also supplies large quantities. The Paris Gas Company utilise their own residues, and produce, together with the other large French towns, at least 250 tons. Belgium—and more so Holland—is very active, and the production in Germany, especially in large towns, such as Berlin and Hamburg, is not inconsiderable, and even America sends her quota, if not in large quantities. Altogether there will be during 1877 an excess of many hundreds of tons of pure anthracene, and consequently low prices. The inevitable reaction will produce a reduction in the price of tar, which already shows itself in Germany. A paper there offers repeatedly, and for some time, six tar contracts without any response: the distillers bide their time, and their English brethren will soon find out, if they have not done so already, the necessity of this line of action.

But—and here I come to the main point of my argument insisted upon in previous communications—the tar distiller must feel to find his advantage in the manufacture of a better and purer article. He must return to the early times of his operations, when with low tar prices a moderate price for anthracene paid him well.

The large stock accumulating during 1877 may somewhat interfere, but after that the permanently reduced prices of tar will enable him to supply genuine anthracene at paying prices.

It is well known that true, pure anthracene passes over at a certain limited stage of the distillation, and this product only was originally sold: the suddenly increased demand for large quantities induced the distiller to separate as much solid hydrocarbons as possible, and thus the quality of anthracene deteriorated to such a degree that any article tested by alcohol, and showing a melting-point of 190° C., was sold as anthracene. The increasing impurity of the merchandise called forth improved methods of analysis, until at last the chemist is obliged to demonstrate, by more delicate tests, that most of the anthracene at present in the market is of a very doubtful character.

I think the tar distiller may well bear this in mind, because upon the good quality of anthracene to a great extent depends the future existence of the alizarine manufacturers, and the more flourishing these the better will be the prices of anthracene.

35, Whitecross Place, Wilson Street,
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ON ANTHRACENE TESTING.

By C. CASPERS.

IN consequence of the publication of Messrs. Meister, Lucius, and Brüning's, "New Method for Ascertaining the Exact Quantity of Pure Anthracene Contained in Crude Anthracene," and by Dr. Frederick Versmann's subsequent Report on his treatment of crude samples "in a different direction," I am induced to publish my views on the above subject, which may be interesting to science and the trade in general.

The analysis of crude anthracene, since this article became of commercial importance, has undergone various remarkable alterations, and certainly great improvements. The alcohol and bisulphide of carbon tests were simply intended to give a guidance as to the insoluble portion in a certain quantity of mixed hydrocarbons contained in the last runnings of coal-tar distillates, and are now entirely out of practice through their unsatisfactory results, though checked by a stipulated melting-point of the residue.

The so-called "Meister, Lucius, and Brüning's Anthraquinone Test," is based upon the action of certain oxidising agents upon anthracene ($C_{14}H_{10}$) only, and at the same time upon the destruction of all other hydrocarbons mixed with it. The obtained residue, treated with a hot solution of dilute caustic—with or without the appendix—is supposed to be a pure oxidised compound of anthra-

cene, viz., anthraquinone ($C_{14}H_8O_2$) an intermediate and valuable article in the manufacture of artificial alizarin.

It is unquestionable that the ascertaining of the portion, which, in more or less crude anthracene, undergoes an oxidation by the above method and shows itself as residue, fairly forms a guidance for the alizarine maker as to the corresponding quantity of alizarine which can be yielded therefrom, and consequently this test has a reasonable basis; but how far—chemically speaking—it may be correct is the question at issue, equally important to anthracene as to alizarine makers.

Since the original anthraquinone test came into use I have always been at a loss to understand why the weight of the oxidised residue should be calculated by a certain coefficient (0.856) into "pure anthracene," and sold by the number thus obtained instead of by the original weight of the residue, because, I may say, nearly all coal-tar distillers, even those who work under the direction of efficient chemists, have unpersuadably to believe that the specific gravities of quinone and anthracene are in proportion like 1000 : 856; and also because the residue itself is the very article the alizarine maker requires and should pay for accordingly.

Messrs. Meister, Lucius, and Brüning's methods are *not* for ascertaining the exact quantity of pure anthracene in crude anthracene, but for ascertaining pure anthraquinone; the latter is the direct result, whereas the former is a calculation therefrom.

I shall hereafter go more fully into the question as to the value of Messrs. Meister, Lucius, and Brüning's proposed treatment of quinone with sulphuric acid, my experiments not having led me, up to the present, to a final conclusion, but this I can say, that the calculation of found quinone into anthracene is quite unnecessary, and this practice ought to be abolished. The price per unit of quinone will soon find its level in the natural course of trade.

With regard to Dr. Versmann's interesting Reports on his separation of crystals from powder, which at the first reading of his elaborate experiments on various samples seems to be a valuable improvement on the hitherto adopted mode of testing, the same will, after carefully examination be found impracticable and unreliable.

It is only fair for me to state that, as a personal friend of the Doctor's, I had, about four months ago, the advantage of being confidentially acquainted by him of his above mode of testing, and that since I have had an opportunity of completing a series of experiments in a similar way as described by him, but with quite different results; yet I can scarcely object to the Doctor's very cautious and reserved remark about the value of his method, viz., that it "may tend to throw some light on the nature of the products obtained." My intention is merely to state some of my results as compared with his own.

Dr. Versmann puts great importance on the ascertaining of the melting-points of his products, based upon the principle that pure quinone melts at 273° C., but he seems to have lost sight of his own most contradictory results in that respect. I refer to his Report about the "Effect of Purifying Two Samples of Anthracene by Two Consecutive Treatments" (CHEMICAL NEWS, vol. xxxiv., p. 193) in which he finds the powder of the "1. Original" not to melt at 300° C.; first treatment, mean, 265° C.; and second treatment, not at 300° C. again. The "2. Original" does not melt at 300° C.; first treatment at 270° C.; second treatment, not at 300° C. What can prove more the instability of the melting-point?

I now may be allowed to state the results of my tests carried on in a similar manner to Dr. Versmann's suggestion. I have separated a number of crystals from the powder previous to the addition of water to the acetic acid, and never could find more nor less than about 0.038 grm., which I can only explain in this way: that 55 c.c. of glacial acetic acid always keep this quantity in solution, and precipitate it in the form of powder after the addition of sufficient water. If, say, 0.10 grm. of this

powder is dissolved in about 10 c.c. of glacial acetic acid by heating, fine needles of quinone crystallise out in the cold, and melt at about 250°C ., which proves that the powder always contains a large quantity of quinone; the original crystals may be purer, but that the powder should be considered as valueless impurities if the melting-points are below 270° or above 280° is vague.

My attention was particularly drawn to Dr. Versmann's table (CHEMICAL NEWS, vol. xxxiv., p. 178), test No. 9, showing 17.8 per cent at 268° , of which 9.8 per cent are crystals and 7.7 powder.

The Doctor gave me a part of the above sample to prove to me the correctness of his statements, but I was unable to find more than 0.038 grm. of powder with a mean melting-point of 281° , whereas he finds 0.077 grm. not melting at 300°C .

Dr. Versmann's method is not worth more than he estimates it at, coinciding with my own views, and I doubt whether he will ever succeed in coming to a satisfactory final conclusion on this point.*

(To be continued.)

THE D-LINES SPECTRA FLAME EXAMINED BY THE BLOWPIPE.

By MAJOR ROSS, late R.A.

(1.) IN 1871, at Mussoorie, India, a friend, Mr. Hennessey, of the Indian Trigonometrical Survey, since elected Fellow of the Royal Society, invited me to inspect the then novel "atmospheric lines" of the solar spectrum, through the large spectroscope lent him by the Royal Society, from the top of a mountain peak.

(2.) From *a priori* considerations, unnecessary to enter into here, I at that time suspected that the "D" absorption lines of the solar spectrum are *water lines*, and not due to sodium; and I communicated my supposition to Mr. Hennessey, who rapidly appreciated the importance of the deductions possible from such a standpoint.

(3.) In the year above mentioned I found that emission of the so-called sodium flame, afforded by *platinum* before the blowpipe, was wholly dependent on keeping the platinum at a red (not white) heat; so that the *same wire*, incandescent, and affording a continuous spectrum at the point of the blue pyrocone, immediately produced an orange (or "D"-lines) tinge again when moved to a cooler part, about a quarter of an inch *inside* the point, and a reddish or rose tint when shifted to the extreme base of the pyrocone.

(4.) I then confirmed this observation by heating a considerable quantity of new clean platinum foil (compactly rolled together by clean steel forceps), which, I ascertained, could not be incandescently heated by the mouth blowpipe, and which therefore never ceased emitting the orange flame.

(5.) *Conclusion from these Experiments.*—It is obvious, here, that if this orange flame (exhibiting spectroscopically only D-lines) be due to sodium, that metal must be in some mysterious manner (a) proportional to the *bulk* of the platinum used, and (b) eliminable from the blowpipe flame according to the *particular part* of the pyrocone touched by the platinum. The logical conclusion, according to the sodium hypothesis, therefore, seems that sodium exists both in pure platinum and in the blue pyrocone produced by the blowpipe, but that that, in a certain state of heat, is required to eliminate it from this, and that this must be only partially employed to develop it in that.

(6.) It was not until February, 1873, that I made any further progress towards a substantiation of the conclusion I had formed in 1871, but that month, having several weeks before successfully fused some phosphoric acid in

a large platinum dish over the flame of a treadle blowpipe in the Royal Artillery Institution laboratory, I repeated the experiment with an ounce of pure crystalline *boric acid*. The platinum dish was cleaned with boiling nitric acid, and subsequently with charcoal powder and distilled water. The fused boric acid seemed beautifully white and pure, but, proceeding to test with it pyrologically, I found it became opaque on cooling, and therefore was utterly useless for the purpose.

(7.) I then became convinced that the apparent waste of my time and boric acid was in reality an immense gain of fact, in furtherance of the conclusion I had so long entertained. Confirming the phenomenon with a new platinum spoon filled with pure crystallised boric acid before the blowpipe, it was impossible to avoid the conclusion that these *bulks* of platinum, respectively heatable only to redness by the different means employed, had not ceased during the operation to emit the orange (or D-lines) flame, which, absorbed by the boric acid in each case, had rendered it opaque on cooling, and useless for pyrological purposes.

(8.) This hypothesis was confirmed in the following manner:—A roll of new platinum foil, similar to (4), secured by a piece of wire (a), was screwed in a geometrical pen along with another wire (b), containing a bead of pure, transparent, fused boric acid, in such a manner that the point of the blowpipe pyrocone, heating (a) to redness, caused the orange (D-lines) flame to impinge upon (b), which, after a short exposure to this treatment, became *opalescent on cooling*.

(9.) All now required to complete the negative evidence (against the hypothesis of sodium being the cause of the D-lines flame) was a proof of the converse of (8), viz., that an undoubted sodium flame *will not and cannot produce* opalescence in a bead of pure fused boric acid. Knowing this to be the case, I went further, and caused the orange flame from a bead of sodium carbonate to impinge upon the opalescent bead (8) from a considerable distance in the geometrical pen. After a few seconds the *opalescence disappeared*, and the bead was perfectly clear on cooling. A ball of cobalt oxide floating in the bead, previously unaffected by the opalescence of (8), was now partially dissolved, giving the whole bead a pink tinge.

(10.) *Conclusions from Experiments (8) and (9).*—The argument generally adopted by the defenders of the sodium hypothesis of the D-lines flame is that the quantity of sodium thus alleged to be indicated by the spectroscope is too minute to be detected by any other means, but we have here incontrovertible evidence (a) that the reaction afforded by the orange flame emitted from platinum in pure fused boric acid is an *exceedingly strong one*, and (b) that it is *exactly the opposite* of that afforded by an undoubted sodium flame. Secondly, to believe that this flame is due to sodium involves the mathematical absurdity of supposing that sodium in combustion can, at one and the same time, *impart opalescence* to boric acid, and *also remove* opalescence from boric acid. It is therefore impossible to believe that the orange flame emitted by red-hot platinum is due to sodium; and if this flame (exhibiting only D-lines in the spectroscope) is not due to sodium in one case it cannot be due to that metal in any.

(11.) If this evidence be admitted, as it apparently must, to be absolutely incontrovertible, I will undertake to prove (in another paper) that the D-lines spectral flame is in reality produced by *water*, in the peculiar combined condition found in *hydrates*, which I have termed "chemical water," and which Dr. F. Guthrie, advancing by other methods of analysis, has termed "solid water."

Destruction of the Vineyards of the Côte d'Or.—M. E. du Mesnil.—The vines of this important district are gradually perishing, though neither in the leaves nor the roots have the most skillful observers been able to find any indications of the phylloxera. The author thinks that some new enemy has made its appearance.—*Comptes Rendus*.

* This was written previously to the concluding part of Dr. Versmann's paper in the last number of the CHEM. NEWS (vol. xxxiv., 201).

ON THE ACTION OF DIFFERENT FATTY OILS UPON METALLIC COPPER.*

By WILLIAM THOMSON, F.R.S.E., F.C.S.

(Concluded from p. 201.)

SERIES II.—LONG STRIPS OF COPPER USED, HALF COVERED WITH OIL.

(Commenced November 9, 1875. Examined August 9, 1876.)

Name of Oil.	Appearance of oil when examined.	Appearance of strip of copper.	Relative amounts of copper contained in solution in the oil.	Relative amounts of the copper salt dissolved by water.	Relative amounts of acidity given to water.
1. <i>Mesina Olive Oil.</i>	Yellowish colour and quite limpid.	Thickly coated with green salt of copper, which hung thickly in flakes from the plate.	Absent.	Absent.	Very small.
2. <i>(Sweet) Olive Oil.</i>	Ditto, but with a slight greenish tinge.	Thickly coated with green copper salt, but not hanging in flakes.	Very small.	Minute trace.	Absent.
3. <i>Cotton Seed Oil.</i>	The appearance of the oil does not seem to have changed; it has left a coagulated rim all round the bottle at the surface, like a series of icicles.	The copper slip is coated with a very thin coating of a dark deposit.	Very small.	Ditto.	Large.
4. <i>Pale Rape Oil.</i>	The oil has a greenish colour; otherwise not changed.	The copper slip is covered with a green salt of copper immediately at the surface of the oil; underneath it is quite bright.	Large.	Small.	Trace.
5. <i>Brown Rape Oil.</i>	Ditto.	The slip is covered immediately at the surface with a green deposit; underneath it is free from green deposit, but slightly covered with a dark deposit.	Large.	Small.	Trace.
6. <i>Castor Oil.</i>	The oil appears to have changed to a distinctly green colour.	The slip of copper at the immediate surface of the oil is covered with a dark deposit; underneath it is <i>almost</i> bright, being slightly covered with a greyish deposit.	Rather large.	Small.	Minute trace.
7. <i>Raw Linseed Oil.</i>	The oil has changed to a deep green colour.	The slip is slightly and irregularly covered with a dark coloured deposit only slightly adhering to the surface of the copper.	Very large.	Very large.	Very large.
8. <i>Palm Nut Oil.</i>	The appearance of the oil has not changed.	The slip is covered with a thick green coating like the one placed in olive oil.	Absent.	Absent.	Rather large.
9. <i>Ground Nut Oil.</i>	Ditto	The slip is covered with a dense coating of green copper salt, the coating being thickest near the surface of the oil.	Trace.	Absent.	Trace.
10. <i>Pure Lard Oil.</i>	The oil has assumed a very slightly greenish shade.	The slip is covered with a thin light green coating.	Moderate.	Trace.	Small.
11. <i>American Tallow Oil.</i>	The oil has the appearance of honeycomb, the cells being formed by the solid fat and mixed with thin oil.	The slip is covered with a dense green deposit of copper salt thickest near the surface.	Absent.	Absent.	Moderate.
12. <i>Common Tallow Oil.</i>	The oil is of a yellowish colour and turbid from crystallisation of solid fat.	Ditto.	Absent.	Absent.	Rather large.

* Read before the British Association, Glasgow Meeting (Section B.).

Name of oil.	Appearance of oil when examined.	Appearance of strip of copper.	Relative amounts of copper contained in solution in the oil.	Relative amounts of the copper salt dissolved by water.	Relative amounts of acidity given to water.
13. <i>North American Neatsfoot Oil.</i>	This oil has undergone no apparent change.	The slip is irregularly covered with green deposit in a net form all over its surface, but thickest nearest the surface.	Small.	Absent.	Absent.
14. <i>English Neatsfoot Oil.</i>	The oil has changed to a distinctly green colour.	The slip is covered with a very slight dark coloured deposit.	Very large.	Small.	Absent.
15. <i>American Sperm Oil.</i>	The oil is of a dark yellowish colour.	The surface of the copper is thoroughly bright. Except in a line where it was touched by the immediate surface of the oil, it has a faint line of a greenish deposit.	Extremely large.	Very large.	Large.
16. <i>Whale Oil.</i>	Oxidation had taken place and penetrated from the surface of the oil to about a quarter of its entire depth, forming it into a hard jelly. Underneath this jelly the oil was quite liquid.	The copper was absolutely bright throughout.	Absent.	Absent.	Very large.
17. <i>Pale Seal Oil.</i>	The oil all round the glass at its surface had coagulated, forming a circle of small icicle looking bodies; otherwise the oil did not seem to have changed.	The copper slip was absolutely bright throughout.	Large.	Large.	Rather large.
18. <i>Mineral Oil (lubricating).</i>	The oil is of a dark reddish yellow colour.	The slip is covered with a very slight brownish deposit.	Absent.	Absent.	Absent.

These results may be classified as follows :—

First. The amount of acid dissolved by the water from the oils seems to bear no relation to the amounts of copper dissolved by the oils. In some cases the acidity is large and the amount of copper found in solution small or absent, and in others the acidity is small and the amount of copper found in solution large.

Second. As a rule, when the amount of copper dissolved by the oil is large the amount extracted by water is also large, but in a few cases this does not seem to be so.

Third. Some oils produced on the surface of the copper slip a complete coating of a green salt of copper of a greater or less degree of thickness, and it is remarkable that those oils which have this action have not in any case dissolved more than a trace or small quantity of the copper, and in some cases no copper in solution was found. The following is a list of the oils which have this peculiar action in the first and second series respectively :—

Series I.	Series II.
Mesina olive oil.	Olive oil.
Olive oil.	Olive oil.
Palm oil.	Palm nut oil.
Foreign neatsfoot oil.	Ground nut oil.
English neatsfoot oil.	American tallow oil.
Tallow oil.	Common tallow oil.
	Lard oil.

Some oils fall partly under this classification inasmuch as they are not completely covered with the green deposit but are not entirely free from it. In the first series two oils have covered some parts of the copper plate with a blackish deposit and other parts with a green deposit, viz., one of the samples of cotton-seed oil and lard oil.

In the second series, where the copper slips stood in the

oils only partly immersed, two samples have produced green deposits only at the point where the slips came in contact with the immediate surface of the oil. These were pale rape-seed oil and brown rape-seed oil, and one where the line of green deposit at the surface was exceedingly narrow and very slight, viz., American sperm oil; lastly, one sample covered the surface of the copper slip with a network of green deposit, viz., North American neatsfoot oil.

It is most remarkable that no samples of fish oil, with the very slight exception above named of American sperm oil, produced any deposit of green salt of copper on the metallic slips; the surfaces of the copper placed in each of the thirteen different samples used in both series having been preserved in a perfectly bright condition.

Fourth. As a rule those oils which dissolved large portions of copper, left the surfaces of the copper slips in as bright, or almost as bright, a condition as when they were first introduced. Of the oils belonging to this class may be mentioned :—

Series I.	Series II.
Refined rape oil.	Pale rape oil.
Linseed oil.	American sperm oil.
Sperm oil.	Pale seal oil.
Raw cod-liver oil.	
Newfoundland cod oil.	
Common seal oil.	

Some oils in the second series, whilst dissolving large quantities of copper, left the surfaces of the metal more or less tarnished. Of these may be mentioned :—Brown rape oil, castor oil, raw linseed oil, English neatsfoot oil.

The following samples dissolved moderate or small quantities of copper, but left the surface of the slips quite bright :—

Series I.

Seal oil.
Pale seal oil.
Whale oil.
Cod oil.
Shark oil.
East Indian fish oil.

Series II.

For Series II., as only three fish oils were employed, only whale oil remains to be placed in this class, although strictly speaking it does not belong to it, as it had not dissolved even a trace of copper. This sample of oil solidified from the surface by oxidation into about one-third the depth of the oil. The oil underneath was quite fluid.

Fifth. The slips of copper in contact with some of the samples were stained more or less with a dark-coloured deposit. The following is a list of those having this peculiar action:—

Series I.

Rape oil (not refined).
Pale cotton-seed oil.
Ordinary cotton-seed oil.
Almond oil.

Series II.

Brown rape oil.
Cotton-seed oil.
Raw linseed oil.
English neatfoot oil.

Lastly. The three samples of mineral oils in both series produced on the copper slips a peculiar characteristic deposit, of a greyish colour.

Many of the samples in the first series dissolved only a trace or very small quantity of copper, but only two were absolutely free from even a trace of that metal, viz., English neatfoot oil and tallow oil. In the second series five samples came under this class, viz., one sample of olive oil, palm nut oil, American tallow oil, common tallow oil, and of whale oil which was protected from the air by a thick coating of oxidised oil on its surface.

With the view to further examine the green copper salt incrustation which had been produced on the slips of copper in some of the oils, I took the slip which had been left in contact with No. 1 olive oil of the second series, which was covered thickly by the incrustation, and from which it hung in flakes: this was carefully scraped off, and part of the excess of oil absorbed by blotting-paper. The incrustation was then transferred to a test-tube, and washed by decantation with petroleum spirit: this dissolved the excess of olive oil, together with a copper salt which coloured the petroleum spirit of a deep blue-green colour on its first treatment. The incrustation was washed so long as the spirit continued to dissolve any copper; the petroleum spirit solution was then filtered, and the filtrate evaporated on a water-bath, to drive off all the spirit. The residue—which consisted of the excess of olive oil, together with the soluble copper salt—was set aside to cool, and in the morning the copper salt was found to have crystallised out in beautiful green feathery crystals.

Ferrocyanide of potassium, added to and shaken with the petroleum spirit solution of the soluble copper salt, at once decolourised the liquor, and threw down all the copper on the ferrocyanide.

The insoluble copper salt, or part of the incrustation, was then submitted to examination. It is a deep green solid, lighter than water, and insoluble in that medium. Part of this salt was placed in a test-tube, and water added, which was gradually heated till about 200° F., when the solid melted to a deep green oily liquid, which floated on its surface. It is insoluble in alcohol, slightly soluble in bisulphide of carbon and in ether, and is decomposed when heated with most of the acids.

Some of the salt was heated in a test-tube with very weak hydrochloric acid, the copper was separated and dissolved in the water solution of acid, whilst a clear, transparent, oily liquid floated on the surface, which when cold solidified to a white compact solid, resembling in appearance bees'-wax. It, however, differs from this and the well-known solid fatty acids by the peculiar way in which it crystallised when placed on a warmed microscope-slide and allowed to cool gradually. When viewed through

the microscope by means of polarised light, it crystallises in beautiful small star-like groups of crystals, which have the power of polarising light. This white body is difficultly soluble in alcohol in the cold, but dissolves with facility in hot alcohol. It is easily soluble in ether. I intend to continue my enquiry into the properties and composition of these bodies.

Royal Institution, Manchester,
September 30, 1876.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS
DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 197.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigsbafen.

As regards recently discovered sources of iodine we have already mentioned the mother-liquor of Chilian nitre. No others of importance have been discovered. Leuchs† indeed points out that the flue dust of blast-furnaces contains compounds of iodine along with other soluble salts. Thus from the dust of the Rosenberg furnace, near Sulzberg, he obtained 0·034 per 1000; from the Komoran furnace, near Herzowitz, 0·042; and from that at Kreutzthal, 0·146, and calculated that 35½ lbs. iodine could be annually prepared at the first-mentioned furnace. But even in the improbable event that the iodine thus occurring could be extracted at a remunerative cost the total production would still be quite insignificant.

As for the total production of iodine there exist few numerical statements from which it can be ascertained. By far the greatest quantity is obtained in England and France. In the year 1871 the quantity produced in Great Britain reached 114,799 lbs., 9-10ths of which came from Glasgow. One of the works there (W. Paterson) in the year 1867 alone produced 112,000 lbs.‡ In France the production in 1867 was 55,600 kilos.; therefore rather less than in England.

In 1868, 40 kilos. were daily prepared at Tarapaca from Chilian nitre (Balard) corresponding to a yearly production of 290 to 300 cwts. This quantity, however, must be considerably reduced if we remember that Stichtl found only 50 per cent of real iodine in a Chilian sample.

The method of extracting iodine is essentially unchanged notwithstanding many proposed improvements.

In the Report of the London Exhibition of 1862, A. W. Hofmann describes the process of Stanford which was then taken up with great zeal, and for which a medal was awarded by the jury. Its principle is the preliminary distillation of the seaweed, and the utilisation both of the volatile products and of the residual charcoal with its mineral constituents. According to this process 20,000 cwts. of seaweed yielded 12,860 litres of empyreumatic oil, 31,000 cubic metres of illuminating gas, and 26 cwts. of iodine, besides other less important products.§ In spite, however, of the favourable expectations which were entertained by experts, this process has evidently failed in practice. The rock on which the invention has been wrecked is the troublesome and costly carriage of the seaweeds, since a great weight of water must be conveyed along with a comparatively small quantity of solid matter. Moride¶ has indeed proposed to improve this method.

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

† Leuchs, *Deutsche Industrie Zeit.*, 1868, 408. *Wagner Jahresber.*, 1868, 75.

‡ *Deutsche Indust. Zeit.*, 1867, 8.

§ *Stichtl, Wagner Jahresber.*, 1869, 221.

¶ *Wagner Jahresber.*, 1864, 186 (from *Journal de Chim. Medic.*).

¶ Moride, *Comptes Rendus*, lxi., 1002. *Moniteur Scient.*, 1866, 445.

He proposed to dry the weeds in portable furnaces where they are obtained, but nothing further has been heard of the distillation of seaweed and the production of iodine from the residual charcoal.

The method of extracting iodine from the mother-liquors of kelp is still the same well-known process over which it is needless to waste a word. New methods have been proposed, but have led to no alterations in practice. We may mention the method invented by Lauroy.* He saturates the mother-liquors of Varec with hydrochloric acid, removes the precipitate thus produced, and passes nitrous and hyponitrous acid into the clear liquid. Iodine is thus precipitated, whilst the bromides, simultaneously present, are not decomposed.

The process of extracting iodine from the mother-liquors of Chili nitre, which was at first introduced by Thiercelin in the works of the Société Nitrière, at Tarapaca, and by which, as has been already stated, 40 kilos. of iodine were obtained there daily, is in brief as follows:—The iodic acid present in the mother-liquors is reduced by an exactly sufficient amount of sulphurous acid. The iodine thus precipitated is placed upon a sand filter in a large stoneware vessel with a perforated bottom, which allows the greater part of the saline liquid saturating the iodine to drain away. It is then transferred by means of stoneware spoons into a trough of gypsum with thick sides, which quickly absorbs the rest of the liquid. The crude iodine thus obtained is either offered for sale in this state or submitted to sublimation. Thiercelin subsequently employed for the precipitation of the iodine nitrous acid, which he obtained by the ignition of a mixture of 5 parts soda-salt-petre, and 1 part charcoal (Duhamel's process for the manufacture of soda).

(To be continued).

CORRESPONDENCE.

NEW REAGENT FOR POTASSIUM.

To the Editor of the Chemical News.

SIR,—In the reports of M. Carnot's experiments upon a new reagent for potassium (CHEMICAL NEWS, vol. xxxiv.,

* Lauroy, *Monit. Scient.*, 1868, 1042.

pp. 85 and 119-120) a peculiarity—if not an error—in the formulæ occurs which is likely to be misleading. Your correspondent "R. P. D.," who writes to correct M. Carnot's figures (p. 122), has already misunderstood his meaning.

M. Carnot, in every instance (excepting one evident typographical error), expresses sulphide of bismuth—in the old notation— Bi_2S_3 instead of BiS_3 as—in that notation—it is generally written. It is written in the same manner in the *Comptes Rendus*, from which one of the articles was translated. Either M. Carnot is in error, or he uses one-half the usually accepted atomic weight for bismuth.

If "R. P. D." will either substitute Bi for Bi_2 in the formula of which he writes, or will halve the weight of bismuth, he will find that M. Carnot's original figures are correct.—I am, &c.,

ALFRED SENIER.

School of Pharmacy, 17, Bloomsbury Square, W.C.,
November 14, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 17, October 23, 1876.

The Electric Effluve.—M. A. Boillot.—Two tubes filled with powdered graphite are fixed in a parallel position side by side, but at a variable distance, depending on the intensity of the electricity and on the nature of the effluve which it is desired to obtain. Each of these tubes is fitted at one end with a platinum wire communicating with the carbon within, these wires being opposed to each other, and placed in external connection with the electric source. The effluve is produced along the entire length of the tubes. The gases to be operated on arrive at one of the extremities of the apparatus, and are collected at the other after having traversed a tube intermediate between the two others filled with carbon, and after having undergone the action of the effluve.

COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

OCTOBER, 1876.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale.	
		Saline.	Organic.								Before Boiling.	After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>												
Grand Junction	Clear	0'000	0'008	0'135	0'084	20'40	8'288	0'396	0'94	1'80	13'80	2'4
West Middlesex	Clear	0'000	0'008	0'135	0'082	20'41	8'064	0'468	1'01	1'66	13'80	2'4
Southwark and Vauxhall	Slightly turbid	0'001	0'008	0'105	0'050	20'20	8'232	0'468	1'01	1'53	13'80	2'3
Chelsea	Clear	0'000	0'007	0'120	0'077	20'90	8'344	0'468	1'01	1'73	13'80	3'8
Lambeth	Clear	0'001	0'007	0'120	0'091	20'06	8'128	0'442	1'01	1'73	14'30	3'3
<i>Other Companies.</i>												
Kent	Clear	0'000	0'000	0'255	0'010	24'24	10'248	0'576	1'13	1'93	18'20	5'1
New River	Clear	0'000	0'004	0'120	0'027	19'38	7'952	0'468	0'87	0'80	14'30	3'3
East London	Clear	0'000	0'005	0'105	0'037	19'51	7'616	0'568	1'85	1'60	13'30	3'4

The quantities of the several constituents are stated in grains per imperial gallon of 70,000 grains.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrates, &c., is determined by a standard solution of permanganate of potash acting for three hours and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

Industrial Applications of the Phosphide of Copper and of Phosphor Bronze.—MM. H. de Ruolz, Montchal, and de Fontenay.—The authors claim priority in the preparation and use of phosphor bronze, of which they have cast several pieces of artillery at Douai from 1854 to 1856. They consider that phosphorus, even in minute doses, when added to melted alloys containing copper prevents oxidation.

No. 18, October 30, 1876.

A New Electric Lamp designed by M. P. Jabloschkoff.—M. L. Denayrouze.—The new source of light is composed of two pieces of charcoal fixed in a parallel position at a little distance from each other, and separated by an insulating substance capable of wasting away at the same speed as the charcoal. When the electric current begins to pass the voltaic arc is formed between the two uncovered extremities of the two charcoals. The nearest layer of the insulating matter melts, is volatilised, and slowly lays bare the two rods of charcoal just as the wax of a candle progressively uncovers its wick as the combustion is propagated downwards. The heat springing from the combustion of the charcoal is utilised for the fusion and volatilisation of the insulating mixture. The composition of this latter may be varied indefinitely, since most earthy matters may be employed. The simplest mixture provisionally adopted consists of sand and powdered glass, which with an equal electric power gives double the light of a regulator. The author has been able to divide the light produced by a single source of the current. With a single Gramme machine of the common make he has caused three sets of charcoals to burn at once.

Distribution of Magnetism on the Surface of Magnets.—MM. Tréve and Durassier.—The authors find that the more highly steel is carburetted the more the magnetism is condensed towards its extremities. On the contrary, the less it is carburetted the more the magnetism is equally spread over its surface.

Circular Polarisation of Quartz.—J. L. Soret and E. Sarasin.—Not suitable for abstraction.

Chemical Reactions of Gallium.—M. Lecoq de Boisbaudran.—When I merely possessed a few milligrams of impure compounds of gallium I admitted, though not without reserve (*Comptes Rendus*, December 6, 1875, p. 1105), that the oxide of gallium is more soluble in ammonia than is alumina. Recent experiments confirm this opinion. Thus, a mixture of the chlorides of aluminium and gallium having been repeatedly treated with an excess of ammonia, the first ammoniacal solution was found very rich in gallium, and the last precipitate consisted exclusively of alumina. A single precipitation with a large excess of ammonia suffices to yield on the one hand a salt of gallium poor in aluminium, and on the other, alumina containing little gallium. If a mixture of the chlorides of aluminium and gallium is subjected to fractional precipitation with carbonate of soda the rays $Ga\alpha 4170$ and $Ga\beta 4037$ are most intense in the first product, and subsequently go on diminishing. Still we cannot, in this manner, arrive at a satisfactory separation of gallium and aluminium. Carbonate of soda only precipitates indium after gallium. It is to be remarked that according to a theory which regards gallium as an intermediate stage between aluminium and indium, the precipitation of the oxide of gallium ought to be intermediate between that of the oxide of indium and that of alumina, and not to precede them both, as observation shows. The chloride and sulphate of gallium, if slightly acid, are not precipitated in the cold by acetate of ammonia, also feebly acid, but the same salts, if neutral, are rendered turbid. An excess of acetate of ammonia renders the liquid clear again, and in that case it no longer grows turbid on heating, unless a large excess of water be added. Chloride of gallium is very soluble and deliquescent. After having been dried it attracts moisture from the air and liquefies:

the solution if very concentrated is clear, but is rendered turbid by the addition of water. The precipitate, doubtless an oxychloride, is only very slowly re-dissolved by dilute hydrochloric acid. Thus, if it be desired to remove all the gallium contained in an insoluble product, it is prudent to heat it with strong hydrochloric acid. If to a concentrated solution of chloride of gallium there is added exactly so much hydrochloric acid that it may be diluted with water without turbidity, we obtain a liquid which precipitates copiously on boiling, but grows clear again on cooling. A slightly acid solution of chloride of gallium, if dried at a gentle heat, deposits crystalline needles or leaflets, which act strongly upon polarised light. Sulphate of gallium is not deliquescent. Like alum, it forms with cold water a clear solution, which becomes turbid in heat, and grows bright on cooling. I have prepared gallium-alum by mixing solutions of the pure sulphates of ammonium and gallium. If protected from atmospheric dust the liquid remains clear, but on contact with a fragment of common alum it deposits voluminous and well-defined crystals of ammonio-gallic alum. The existence of this salt, therefore, is no longer doubtful.

On Terephthalic Aldehyd.—M. E. Grimaux.—Not suitable for abstraction.

Simultaneous Formation of Two Trioxanthraquinones, and the Synthesis of a New Isomer of Purpurin.—M. A. Rosenstiehl.—This paper will be inserted in full.

Bulletin de la Société Chimique de Paris,
Nos. 6 and 7, October 5, 1876.

Nitro- and Amido-Naphthyl Sulphurous Acids, and on their Derivatives (Part II.)—M. P. T. Clève.—An examination of naphthionic acid, diazo-naphthionic acid, and of the dichloro-naphthalin derived from naphthionic acid.

Two New Modifications of Dichlorated Naphthalin.—M. P. T. Clève.—These are δ -dichloro-naphthalin, $\delta C_{10}H_6Cl_2$; and ϵ -dichloro-naphthalin, $\epsilon C_{10}H_6Cl_2$.

Explanatory Note on the Atomic Theory.—M. E. Bourgoin.—The few lines which follow are not designed to refute the new critical observations which have been addressed to the author in relation to his memoir on atomicity. They are merely intended to rectify two or three assertions which have been gratuitously ascribed to him, and the authorship of which he refuses to admit. He has been made to say that all atomic formulæ spring from the type-formulæ of Gerhardt. He has never put forward such an opinion. It is imagined that he admits the atomic weights of simple bodies to be proportional to their gaseous densities. He has never said anything similar, for the very simple reason that he no more believes in atoms than in the atomic theory, even as perfected by M. J. A. Le Bel.

Various Notes on Analytical Chemistry.—H. Pellet.—Reserved for insertion in full.

Ferrocyanide of Tetramethyl-ammonium.—M. L. Barth.—This compound is obtained by neutralising a solution of hydrate of tetramethyl-ammonium with hydroferrocyanic acid.—*Deutsche Chem. Ges.*

Action of Halogens upon Ferricyanide of Potassium.—M. Skraup.—By the action of a mixture of ClO_3K and HCl upon a neutral solution of ferricyanide of potassium, and by adding alcohol, the author obtained small black drops, which ultimately became a black crystalline mass. This is doubtless the same body which Bong obtained by the action of chloric acid upon ferrocyanide.—*Deutsche Chem. Ges.*

Compounds of Sulpho-Urea with the Metallic Salts.—M. R. Maley.—An examination of the compounds of sulpho-urea with the zincic, stannous, and mercuric chlorides, cadmic sulphate, and mercuric iodide.—*Deutsche Chem. Ges.*

Derivatives of Sulpho-Urea.—MM. Claus and Rimbach.—The authors describe the reaction of sulpho-urea and trichloro-acetic acid.

Substitution Derivatives of Oxide of Ethylen.—M. E. Demole.

Researches on Ethyl- and Methyl-Oxamethan.—O. Wallach and P. West.—These two papers do not admit of useful condensation.

Tetra-Substituted Ureas.—M. W. Michler.—A preliminary notice.

On Oxymercaptans.—R. Biedermann.—The author is engaged with attempts to introduce the group SH into phenol, and the group OH into thiophenol.—*Deutsche Chem. Ges.*

On Gaulterylen.—R. Biedermann.—The author confirms the view of Cahours that this compound is a terpen of the formula $C_{10}H_{16}$.

Action of Cyanide of Potassium upon Halogenated Compounds.—MM. Claus and Beuttel.—Chloro-crotonic ether in an alcoholic solution is treated under pressure with cyanide of potassium. The products are two acids, one of which has received the name of the tricarballic. —*Deutsche Chem. Ges.*

Product of the Reaction of Potassium upon the Succinate of Ethyl.—Ira Remsen.—This product, which represents the ether of a disuccinic acid, has been further examined by the author.

Amidated Acids.—J. W. Brühl.—An examination of the derivatives of α -chloro-propionic ether.

Hydrazinic Compounds of the Fatty Series.—M. E. Fischer.—The compounds studied by the author are nitroso-diethylen, nitroso-diglycolamidic acid, and nitroso-piperidin. There is also a paper by the same author on the "Aromatic Hydrazinic Compounds."

Aromatic Nitriles.—V. Merz and K. Schelnberger.—Nitriles are formed by the action of yellow prussiate upon the halogenous aromatic carbides.

Action of Aniline upon Nitrobenzol.—MM. Dechard and Wichelhaus.—Already noticed.

Meta-chloro-nitro-benzol, and on certain Chlorinised Nitrogenous Compounds.—M. A. Laubenheimer.—Not adapted for condensation.

Extraction of Sulphur from Pyrites.—P. W. Hofmann.—If sulphide of calcium—e.g., the vat-waste from alkali works—is heated to dull redness in a current of sulphurous acid gas, obtained by roasting pyrites, the latter is at first completely absorbed. Sulphur then distils over, and the sulphide is converted into sulphate, which may be anew reduced to sulphide by calcination in a current of coal-gas.—*Deutsche Industrie Zeitung.*

On Aniline-Black.—M. Nietzki.—Reserved for insertion in full.

On Pittacal.—M. C. Liebermann.—Reserved for insertion in full.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 7, October 19, 1876.

This issue contains no original chemical matter.

Society of Public Analysts.—We are informed on good authority that the Treasurer of the Society of Public Analysts (Dr. Stevenson) has sent in his resignation and retired from the Society.

MEETINGS FOR THE WEEK.

SATURDAY, NOV. 18th.—Physical, 3. "On the Cohesion or Capillary Action of Films of Water, especially when holding Solid Bodies in Suspension against the Action of Gravity," by Alfred Tylor.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 887.

ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 210).

100. EXPERIMENTS were first tried in air of normal density. The pump was then set to work, and observations were taken at different heights of the gauge. The difference between the height of the gauge and that of the barometer gave the tension of air in the apparatus in millimetres of mercury; this is recorded in the first column of the following tables. The second column gives the greatest amplitude of the half oscillation of the pendulum in millimetres—the sign *plus* signifying attraction, and *minus* repulsion.

Near the centre of Table I., in the second column, are five observations to which I have affixed no sign. When trying the experiments I thought that either I had mistaken the direction of impulse, or my assistant had commenced to count the make-and-break seconds wrongly, as the movement *seemed* to be repulsion. Never having had repulsion at such a pressure before, I was not prepared for it; and fearing there might be an error, left the sign queried. Another series of observations were taken to re-examine this point; they are given in Table II.

TABLE I.

Tension of enclosed air, in millims. of mercury. Temp. = 16° C. Bar. = 772.55 millims.	Amplitude of half oscillation, in millims., at end of 40" observation.
772.55	+0.46
557.50	+0.54
472.00	+0.49
372.00	+0.39
322.00	+0.41
272.00	+0.28
242.00	+0.18
222.00	+0.15
201.00	+0.11
167.00	+0.12
140.00	0.07 ?
114.50	0.08 ?
89.50	0.12 ?
70.50	0.03 ?
54.00	0.02 ?
48.00	+0.12
37.00	+0.14
29.00	+0.14
20.00	+0.18
14.00	+0.30
9.15	+0.46
6.55	+0.66
4.65	+1.00
3.15	+1.40
2.25	+1.48
1.15	+1.72
0.75	+1.70
0.65	+1.46
0.55	+1.04
0.35	+0.64
0.25	-0.60
0.15	-1.16
-0.05	-5.90

It is worthy of notice in these Tables that the attraction by the incandescent spiral is only moderate in air of ordinary density. The attraction diminishes to a minimum between a tension of 50 millims. and 150 millims., then rises as the pressure diminishes, until, at a tension of 1.15 millims., the attraction is nearly four times what it was in dense air. Above this exhaustion the attraction suddenly drops and changes to repulsion, which at the best vacuum I could get was nearly thirteen times stronger than the attraction in air.

TABLE II.

Tension of enclosed air, in millims. of mercury. Temp. = 16° C. Bar. = 772 millims.	Amplitude of half oscillation in millims. at end of 40" observation.
772.0	+0.460
770.0	+0.540
769.5	+0.570
769.0	+0.440
769.0	+0.520
769.0	+0.440
769.0	+0.450
565.0	+0.560
557.0	+0.540
472.0	+0.490
440.0	+0.550
369.0	+0.416
213.0	+0.233
207.0	+0.130
189.0	+0.180
173.0	+0.140
164.0	+0.100
162.0	-0.100
142.0	-0.120
132.0	-0.130
127.0	-0.090
105.0	-0.140
102.0	+0.083
73.0	-0.130
60.0	-0.123
56.0	-0.136
51.0	-0.030
41.0	+0.150
33.5	+0.170
32.0	+0.106
23.0	+0.110
22.0	+0.080
16.1	+0.170
16.0	+0.140
7.1	+0.380
6.0	+0.293
3.9	+0.610
1.9	+0.880
1.2	+0.755
0.9	+0.340
0.7	-0.740
0.6	-1.700
0.3	-3.800
0.2	-5.080
0.0	-5.680
-0.05	-6.320

The last figure in the first column requires explanation. All the others are obtained by subtracting the height of the gauge from that of the barometer, and are *positive*. At the highest rarefactions, however, I get the gauge about 0.05 millim. above the barometer (85, *note*); the sign, therefore, becomes *negative*.

Table II. agrees in the main with Table I. The sign changes to repulsion at pressures corresponding to those queried in Table I.; the repulsion, though slight, was unmistakable. At 102 millims. pressure the observation has a positive sign. This looks like an error; but as it is so recorded in my notebook, and as I was at that time specially looking for repulsions, I do not feel justified in

* A Paper communicated to the Royal Society, March 20, 1875. From the *Philosophical Transactions of the Royal Society of London* vol. clxv., pt. 2.

altering it. What I have called the neutral point, or the point where attraction changes to repulsion, is in this series lower than in the former. There it occurred at a tension of about 0.3 millim. of mercury; here at about 0.8. Neither does the previous attraction attain such strength, although the ultimate repulsion is more intense. The agreement is, however, sufficiently satisfactory, considering the faulty method of measurement.

There are many errors almost inseparable from this form of apparatus. The making and breaking contact by hand is not sufficiently certain, and hesitation for a fraction of a second would seriously affect the ultimate amplitude of arc. I tried making and breaking by clockwork, also by a seconds' pendulum, but there were difficulties in each plan.

Owing to the mode of suspension, there was uncertainty as to the length of the pendulum. I tried to make it the right length to beat seconds *in vacuo*. Assuming that I had succeeded in this, the pendulum would have executed fewer vibrations in the 40 seconds when oscillating in air, and consequently I should not have got the full benefit from the making and breaking contact, supposing these were accurately timed to seconds.

The battery-power varied, being stronger at the commencement, and gradually declining towards the end of the experiment; and even were the battery to remain constant, the spiral became much hotter, owing to the removal of the air from the apparatus, ranging from a bright red heat in air to a full white heat *in vacuo*.

Owing to the height of the centre of suspension of the pendulum from the stand of the apparatus, the slightest deviation from the perpendicular made an appreciable difference in the distance of the weight from the spiral, and thereby increased or diminished the effect of radiation. Thus the tread of a person across the floor of the laboratory, or the passage of a cart along the street, would cause the image of the edge of the magnesium weight apparently to move from the cross wires in the telescope.

Many of these sources of error could have been removed; but in the meantime having devised a form of apparatus which seemed capable of giving much more accurate results, I ceased experimenting with the pendulum.

Before proceeding to describe the apparatus subsequently employed, I may mention that a candle flame brought within a few inches of the magnesium weight, or its image focused on the weight and alternately obscured and exposed by a piece of card at intervals of one second, will soon set the pendulum in vibration when the vacuum is very good. A ray of sunlight allowed to fall once on the pendulum immediately sets its swinging. The pendulum apparatus above described was exhibited, and experiments shown with it, at the Royal Society, April 22nd, 1874, and also before the Physical Society,* June 20th, 1874.

(To be continued).

COMPOUND OF CHROMIUM ARSENIC.

By R. H. C. NEVILLE.

I THINK that a short notice of a compound of which I have seen no mention in any book may not be without interest to your readers. On pouring a hot and strong solution of pure chromic acid into a hot and saturated (or nearly so) solution of arsenious acid, the liquid in the first instance becomes green, still remaining transparent. If, however, it be kept at nearly the boiling-point it gradually becomes opaque by reflection, but transparent by transmission, light, and finally a dark green powder falls. On washing this powder thoroughly and analysing it, it was found to have the following composition:—

Chromium	29.8
Arsenic	42.7
Oxygen (by diff.)	27.5
	100.0

This agrees very closely with the formula CrAsO_3 , which would be—

Chromium	30.0
Arsenic	42.8
Oxygen	27.2
	100.0

I think we may reasonably conclude that the powder is an arsenite of chromium. I am now engaged in preparing a further quantity of it (having only prepared a small quantity on the former occasion) with a view to further investigation.

Chemical Laboratory, Catholic University College,
Wright's Lane, Kensington.

REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 216.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

G. LANGBEIN reports that he has introduced another process in the works of the firm Gildemeister and Co., as the process of Thiercelin disregards the iodine existing as sodium iodide along with the iodic acid. This does not, however, apply to the more recent method of Thiercelin, since hydriodic acid is very readily decomposed by nitrous acid.

The compounds of iodine find little application in manufactures, and are therefore merely produced on a small scale. Proposals for improved methods of preparation are therefore of limited interest and require but a very brief notice.

For the preparation of the iodides of potassium, calcium, and lithium Liebig† proposes to form a solution of phosphoric and hydriodic acids by the reaction of amorphous phosphorus, iodine, and water, and to saturate the acid liquid with caustic baryta. Phosphate of baryta is precipitated and iodide of barium remains in solution, from which (Pettenkofer) any desired iodide may be obtained by precipitation by means of a sulphate. In preparing calcic iodide the acid may be neutralised with milk of lime.

Rud. Wagner‡ proposes to form the iodides by decomposing sulphites with iodine. For this purpose the sulphite of barium is particularly adapted, which is diffused in water and treated with iodine, yielding sulphate of baryta, marketable as *blanc fixe* and iodide of barium. But the process already in use of reducing sulphate of barium and decomposing the sulphide thus obtained with iodine is evidently simpler.

Fluorine.—Fluorine, which it was hoped would, in its compounds, prove capable of important industrial applications, has in no manner fulfilled the expectations entertained. Many attempts made with this view down to the year 1867 have proved fruitless. Amongst such we may remember the proposal of Weldon|| to prepare soda by

* "Berichte über die Entwicklung der Chemischen Industrie während des letzten Jahrzehends."

† Liebig, *Ann. Chem. Pharm.*, cxxi., 222. *Wagner Jahresber.*, 1862, 257.

‡ Wagner, Bayer, Kunst, &c., *Gewerbbl.*, 1862, 235. *Wagner Jahresber.*, 1862, 261.

|| Weldon, *Dingl. Pol. Journ.*, clxxii., 228.

means of hydrofluoric acid. A solution of sulphate of soda was decomposed by means of hydrofluoric acid, obtained either by heating a mixture of magnesium fluoride and sulphuric acid, or by decomposing sodium fluoride with superheated steam. The sulphate of soda was thus to be resolved into bisulphate, which remains in solution, and sodium fluoride, which separates out. This latter salt is either converted into hydrofluoric acid and hydrate of soda by means of superheated steam or converted into hydrate of soda and magnesium fluoride by the addition of magnesia. The magnesia necessary for this purpose is obtained by heating common salt with Epsom salt ($MgSO_4 + H_2O$), forming magnesia, hydrochloric acid, and sulphate of soda, which latter, as above mentioned, serves for the preparation of the sulphate of soda. The magnesium fluoride formed by decomposing the sodium fluoride with magnesia serves for the preparation of hydrofluoric acid, being heated along with the acid sulphate of soda obtained in the first operation, and thus converted into sulphates of magnesia and soda and hydrofluoric acid, the latter being again applicable for the decomposition of sulphate of soda. Thus all the materials required for the manufacture of soda are regenerated, and merely the common salt and the fuel are consumed. According to the inventor the cost of plant, fuel, &c., is smaller than in Le Blanc's process. As a shorter process Weldon suggests to convert common salt at a red heat into sulphate of soda and hydrochloric acid by means of bisulphate of soda. The sulphate of soda is then dissolved in water, and split up into sodium fluoride and bisulphate of soda by means of hydrofluoric acid, and from the sodium fluoride the hydrofluoric acid is recovered by treatment with superheated steam, hydrate of soda being the final product of this series of reactions. Notwithstanding the alleged remunerative nature of these processes neither of them has found its way into practice.

(To be continued.)

ON THE
CALCULATION OF THE RESULTS OBTAINED
FROM THE ANALYSES OF SUPERPHOSPHATES,
MANURES, &c.

By R. C. WOODCOCK, F.C.S.,
Royal Agricultural College, Cirencester.

There are probably few substances met with during the ordinary course of commercial analyses that require a more tedious set of calculations than a superphosphate. Having frequently to do these calculations, I was induced to make up the following set of tables, which give the

required result (with great accuracy) in a far shorter time than when the ordinary method is adopted; the chances of a mistake are also greatly reduced. For every fraction of a grm. of the various precipitates obtained, the substance sought may at once be found by looking under its number in the table, and removing the decimal point as the case may require. An example is given, which I trust will at once make the matter quite clear, and show the shortness of the method:—

Calculations for a Superphosphate.

P_2O_5 soluble in cold water, existing as $\text{CaH}_4\text{P}_2\text{O}_8$.
1 grm. gave 0.1995 $\text{Mg}_2\text{P}_2\text{O}_7 = 19.95$ per cent $\text{Mg}_2\text{P}_2\text{O}_7$.
Required, the per cent of $\text{CaH}_4\text{P}_2\text{O}_8$:—

10°00	=	10°5405000
9°00	=	9°4864500
0°90	=	0°9486450
0°05	=	0°0527025

$$19.95 = 21.0282975 \text{ CaH}_4\text{P}_2\text{O}_8.$$

Required, water lost by the $\text{CaH}_4\text{P}_2\text{O}_8$ on ignition, to be subtracted from the total loss on ignition, which would otherwise be counted as "organic matter and combined water":—

10'00	=	1'6216000
9'00	=	1'4594400
0'90	=	0'1459440
0'05	=	0'0081080

$$19.95 = 3.2350920 \text{ OH}_2 \text{ in } 19.95 \text{ CaH}_4\text{P}_2\text{O}_8.$$

Insoluble P_2O_5 existing as $Ca_3P_2O_8$, obtained by subtracting the soluble P_2O_5 ($Mg_2P_2O_7$) from the total quantity, *i.e.*, the portion dissolved in HCl.

1.1045 grms. gave 0.2595 $\text{Mg}_2\text{P}_2\text{O}_7$.

1:1045:0.2595 :: 100: $x = 23.49$ p.c. total $\text{Mg}_2\text{P}_2\text{O}_7$
19.95 " soluble "

3'54 „ insoluble „

Required the per cent of $\text{Ca}_3\text{P}_2\text{O}_8$:—

3'00	=	4'1891700
0'50	=	0'6981950
0'04	=	0'0558556

$$3.54 = 4.9432206 \text{ Ca}_3\text{P}_2\text{O}_8.$$

1.1045 grms. gave 0.508 CaCO_3 .

Required the per cent of CaSO_4 :—

$$1.1045 : 0.508 :: 100 : x = 45.99 \text{ per cent CaCO}_3.$$

CaCO_3 to be deducted from the total quantity, for Ca contained in $\text{CaH}_4\text{P}_2\text{O}_8$:—

Found.	Sought.	1.	2.	3.	4.	5.	6.	7.	8.	9.
Mg ₂ P ₂ O ₇	CaH ₄ P ₂ O ₈	1'05405	2'10810	3'16215	4'21620	5'27025	6'32430	7'37835	8'43240	9'48645
Do.	Ca ₃ P ₂ O ₈	1'39639	2'79278	4'18917	5'58556	6'98195	8'37834	9'77473	11'17112	12'56751
Do.	CaCO ₃ for CaH ₄ P ₂ O ₈	0'45045	0'90090	1'35135	1'80180	2'25225	2'70270	3'15315	3'60360	4'05405
Do.	CaCO ₃ for Ca ₃ P ₂ O ₈	1'35135	2'70270	4'05405	5'40540	6'75675	8'10810	9'45945	10'81080	12'16215
Do.	OH ₂ in CaH ₄ P ₂ O ₈	0'16216	0'32432	0'48648	0'64864	0'81080	0'97296	1'13512	1'29728	1'45944
Do.	P ₂ O ₅	0'63964	1'27928	1'91892	2'55856	3'19820	3'83784	4'47748	5'11712	5'75676
Do.	Ca ₃ P ₂ O ₈	1'64789	3'29578	4'94367	6'59156	8'23945	9'88734	11'53523	13'18312	14'83101
Do.	CaCO ₃ for CaH ₄ P ₂ O ₈	2'18310	4'36620	6'54930	8'73240	10'91550	13'09860	15'28170	17'46480	19'64790
Do.	CaCO ₃ for CaH ₄ P ₂ O ₈	0'70422	1'40844	2'11266	2'81688	3'52110	4'22532	4'92954	5'63376	6'33798
Do.	CaCO ₃ for Ca ₃ P ₂ O ₈	2'11268	4'22536	6'33804	8'45072	10'56340	12'67608	14'78876	16'90144	19'01412
Do.	OH ₂ in CaH ₄ P ₂ O ₈	0'25352	0'50704	0'76056	1'01408	1'26760	1'52112	1'77464	2'02816	2'28168
CaCO ₃	CaSO ₄	1'36000	2'72000	4'08000	5'44000	6'80000	8'16000	9'52000	10'88000	12'24000
PtCl ₄ 2KCl	K ₂ O	0'19287	0'38574	0'57861	0'77148	0'96435	1'15722	1'35009	1'54296	1'73583
PtCl ₄ 2AmCl	Am ₂ SO ₄	0'29583	0'59166	0'88749	1'18332	1'47915	1'77498	2'07081	2'36664	2'66247

10'00 = 4'5045000
9'00 = 4'0540500
0'90 = 0'4054050
0'05 = 0'0225225

19'95 = 8'9864775 CaCO₃.

CaCO₃ to be deducted from the total quantity, for Ca contained in Ca₃P₂O₈ :—

3'00 = 4'0540500
0'50 = 0'6756750
0'04 = 0'0540540

3'54 = 4'783779 CaCO₃

8'99 CaCO₃ for 21'03 CaH₄P₂O₈
4'78 " " 4'94 Ca₃P₂O₈

13'77 total CaCO₃ to be deducted.

45'99 per cent total CaCO₃
13'77

32'22 CaCO₃ existing as CaSO₄.

30'00 = 40'8000
2'00 = 2'7200
0'20 = 0'2720
0'02 = 0'0272

32'22 CaCO₃ 43'8192 CaSO₄.

It is possible that many chemists would rather calculate out their results by the ordinary method than trust to any tables to do the work for them; but even to these I feel sure they will be of service, if only used to check the calculations.

I have calculated the amounts of various substances (CaH₄P₂O₈, &c.) which correspond to found amounts of Mg₂P₂O₇, and those which correspond to given amounts of P₂O₅; for in some cases it may be convenient to calculate out the P₂O₅ at once. I may mention that the "atomic weight" of calcium is taken as 40, and that of platinum as 197'2. PtCl₂KCl is calculated into K₂O and PtCl₂AmCl into Am₂SO₄.

It will be seen that these tables are arranged in a similar manner to those given by Fresenius, for the calculation of various substances found, into their required results.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 16th, 1876.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, the names of Messrs. Edward Horatio Walker Sweete and Channell Law were read for the third time. They were then ballotted for and duly elected.

The first paper, "On Barwood," by the late Professor ANDERSON, was then read by the SECRETARY. On extracting barwood successively with ether and with alcohol, and evaporating the solution, a crystalline compound, *baphnin*, C₂₄H₂₀O₈, is obtained, together with amorphous substances of a red colour. When *baphnin* in alcoholic solution is treated with acetate of lead, a white precipitate of lead baphate is obtained, together with *baphnitin*, C₂₄H₂₄O₆, which remains in solution. A similar decomposition takes place on submitting *baphnin* to the action of a solution of potassic hydrate. *Baphic acid*, C₂₄H₂₂O₁₀, may be obtained from the lead precipitate by decomposing

it with sulphuretted hydrogen. The author also obtains another compound, *baphinitone*, C₂₄H₂₆O₆, which by the action of bromine yields a tribromo derivative, C₂₄H₂₃Br₃O₆.

THE PRESIDENT having thanked Dr. E. J. Mills for communicating this paper to the Society,

Dr. C. R. A. WRIGHT, gave a short abstract of Part I. of his memoir on "The Alkaloids of the Aconites: on the Crystallisable Alkaloids contained in Aconitum Napellus." After referring to his preliminary notice on the subject (containing an account of *pseudo-aconitine*, C₃₆H₄₉NO₁₁, the uncrystallisable alkaloid of *A. ferox*, which, however, yields well-defined crystallisable salts) he stated that very different results were obtained with *A. Napellus*. In one batch of 1 cwt. of roots, which were worked up, two alkaloids were found, one of which, existing in comparatively small quantity, readily crystallised from ether, whilst the other did not. The latter, however, yielded crystalline salts, which have a bitter taste, but do not produce the peculiar prickling of the tongue so characteristic of aconite roots. This base, which is comparatively inert, may be called *picroaconitine*, C₃₃H₄₅NO₁₀. The crystalline base *aconitine*, C₃₃H₄₃NO₁₂, which possesses high physiological activity, can only be obtained pure after repeated crystallisation, first in the free state, and then as a salt, finally liberating the base by ammonia or an alkaline carbonate. In a second quantity of 2 cwts. of the roots worked up to a condensed extract by Messrs. Hopkin and Williams according to Duquesnel's process, only one crystallisable alkaloid, *aconitine*, was found. The hydrochloride, hydrobromide, and gold salt of this base, all of which are crystalline, were prepared and carefully examined.

THE PRESIDENT thanked the author for this communication on a subject so important, both from a chemical and medical point of view, and hoped that he would soon lay before them the results of his experiments on the changes produced on the alkaloid by various reagents.

Mr. DAVID HOWARD remarked that it was a point of peculiar interest to ascertain how far the difference in the alkaloids was due either to diversity of species or to diversity of growth, occasioned by difference of climate or soil.

Mr. W. N. HARTLEY, Mr. C. E. GROVES, and Mr. W. H. PERKIN called the attention of the members to marked differences produced in plants from circumstances of climate, soil, season of collecting, &c., which had come within their personal experience.

Mr. J. WILLIAMS said he had every reason to believe that the different batches of roots employed had grown wild in Switzerland, and were even from the same bale. He was of opinion that the different results obtained were due to alterations in the process. In the first extraction a stronger acid was used: it was heated for a longer time, and having been made much more dilute had to be concentrated more. It was not improbable that the *picroaconitine* was really an alteration-product of the *aconitine*.

Dr. WRIGHT replied that he had at first been inclined to believe that *picroaconitine* was an alteration-product formed by the action of hydrochloric acid on the *aconitine*, but Mr. Groves, of Weymouth, on extracting different samples of the roots by the same process, had in one instance obtained *picroaconitine*, whilst in others it was not found. It would be interesting to ascertain if any alkaloid could be obtained from the marc. It was possible that the *aconite* existed in the extract in the form of a compound similar to a glucoside.

The next paper was by Mr. G. S. JOHNSON, "On Potassium Tri-iodide." This was obtained by dissolving iodine to saturation in an aqueous or alcoholic saturated solution of potassium iodide, and evaporating slowly over sulphuric acid. At first potassium iodide is deposited in cubes coloured by free iodine, but these, after some days, are succeeded by lustrous prismatic crystals of the tri-iodide KI₃, resembling iodine in appearance. It is very deliquescent, and is decomposed by water with liberation of

odine, but may be crystallised from alcohol. Two fine specimens of the crystals were exhibited.

The last communication was "*On the Coal-Gas of the Metropolis*," by Mr. T. S. D. HUMPIDGE. The gases examined were those of the Imperial, five of the Chartered, collected at different stations, and the cannel-gas supplied to the Houses of Parliament, all during the month of May, 1876. The illuminating power was taken, and the gases carefully analysed, determinations being made of the carbonic anhydride, oxygen, nitrogen, marsh-gas, carbonic oxide, and the hydrocarbons absorbed by sulphuric anhydride. From a comparison of the results with those obtained by Dr. Frankland in 1851 (twenty-five years ago), the author is of opinion that the gas now delivered in London is no better than it was then, and that the increase in the illuminating power announced from the various testing stations is to be attributed to improvements in the test-burner; a comparison of the present referees' test-burner with that used prior to 1860 showing a difference of more than three candles.

Dr. FRANKLAND remarked that it seemed rather a melancholy fact, that although Parliament had spent much time and trouble on the matter, and had raised the standard from 14 to 16 candles, yet substantially the gas was the same as in 1851, and we were actually no better off now than we were then.

Mr. W. VALENTIN said most of the photometric observations had been made in the morning or in the afternoon, when the gas was perhaps not so good as it was in the evening, the time when the Act of Parliament provides that it should come up to the standard of 16 candles. Some, at all events, of the percentage of hydrocarbons was due to naphthalene, and not to olefines or benzene. This was a source of great inconvenience, by causing obstructions in the service-pipes, &c.

In reply to a question by Mr. VERNON HARCOURT, Dr. FRANKLAND said that in his experiments he had found that for a given quantity of hydrocarbon vapour, diluted with a mixture of marsh-gas and hydrogen, the illuminating power was sensibly the same whether the diluent contained 60, 25, or only 15 per cent of marsh-gas, from which he concluded that marsh-gas was as much without illuminating power as hydrogen. There could be no doubt that benzene gave a very much higher illuminating power than hydrocarbons of the $C_n H_{2n}$ and $C_n H_{2n+2}$ series, but he could not understand Berthelot's statement that coal-gas owed its illuminating power chiefly to benzene. Although this might be true of the Paris gas, it certainly was not of the London gas. He might state that all the gases mentioned in his report in 1851 were collected in the daytime, and the photometric power determined in the day. On reference to Mr. Humpidge's results it would be seen that one of his determinations, made at 9.30 a.m., came fully up to the standard, as it was 16.3. He thought the most important point in the paper was that it showed that the apparent increase in illuminating power was really due to the improvement of the test-burner, which with the same gas gave a light of 16 candles instead of 13 as the old one did.

Mr. WILLS said his experience did not bear out the statement that the gas was no better now than it was twenty-five years ago. He was in the habit of examining the gas made by several of the large companies. They now supplied a gas up to the standard of 16 candles instead of 12 candles as in 1851. Of this increase only two candles was due to improvement in the burner, and not three as stated by Mr. Humpidge, leaving a clear gain of two candles.

The PRESIDENT, after some remarks on the gas manufactured at Woolwich by the Government, adjourned the meeting until Thursday, December 7, when the following papers will be read:—(1) "Analysis of a Species of Erythrophyll," by Prof. Church; (2) "On Phenylendiamin," by Dr. Otto Witt; (3) "On Calcium Sulphate," by Mr. Hannay.

PHYSICAL SOCIETY.

November 18th, 1876.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidates were elected members of the Society:—Major W. Malcolm, R.E.; Prof. J. M. Purser; Dr. W. Francis; Mr. G. Johnstone Stoney; and Mr. D. MacAlpine.

Mr. TYLOR read a paper on the "*Cohesion and Capillary Action of Films of Water under Various Conditions*." The author endeavours to eliminate the action of all forces except that of gravity by immersing his "valves" in water. The models which he exhibited consisted of glass tubes, about 3 inches in diameter and 6 inches high, filled with water, and containing each a piston, which, on being raised, was capable of lifting by cohesion a heavy mass of metal, the nature of the surfaces in contact differing in the several instruments. From experiments with them he concludes that the time during which a heavy valve can be supported depends upon the size of the surface of contact, the difference of pressure within and without the moving parts, and the smoothness of the valve. On the contrary, dry bodies—such as Whitworth's surface planes—will adhere for an indefinite period. Mr. Tylor considers that the supporting of a body in water is due to a difference of pressure in the water itself, and he adduced Giffard's injector as showing that such differences can take place. He has also studied the form assumed by a drop of water at a tap, and considers that when a fly walks on a ceiling its weight acts in the same manner as the heavy valves in the models exhibited.

Prof. SHELLEY exhibited some of Sir Joseph Whitworth's surface planes and gauges, and showed their bearing on the subject.

Dr. STONE then projected on to the screen the spectra produced by the diffraction gratings which he exhibited at the last meeting of the Society. When received on a screen at a distance of about 25 feet they showed bright bands in the red and violet after transmission through a strong solution of permanganate of potash. Mr. Clark has since ruled for him gratings on the backs of right-angled prisms, and Dr. Stone has cemented—by means of glycerin or oil of cassia—gratings on glass and steel on such prisms. The lines were two thousand and three thousand to the inch.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 3rd, 1876.

REV. WILLIAM GASKELL, M.A., in the Chair.

"*On the Action of Water and Saline Solutions upon Lead*," Part II., by M. M. PATTISON MUIR, F.R.S.E., Assistant Lecturer on Chemistry, Owens College.

1. I have already in several places* described the results of various series of experiments, undertaken with a view to arrive at definite measurements of the solvent action of dilute saline solution upon lead, and to ascertain the circumstances which condition this action. The general results of these experiments may be summed up briefly as follows:—

(1.) Nitrates cause water to exert a very marked solvent action upon lead.

(2.) Carbonates, sulphates, and chlorides greatly diminish the solvent action of water upon lead.

(3.) These three salts, along with nitrates, greatly decrease or even stop the solvent action exercised by the nitrates when present alone.

* Proc. Glasgow Phil. Soc., 1871-72, 184; Soc. Sc. Manchester Lit. and Phil. S.

(4.) The amount of lead increases with the length of time during which the water remains in contact with the lead.

(5.) Water charged with carbon dioxide exercises no very marked solvent action upon lead, but when the water is charged with the gas under pressure the solvent action is very greatly increased.

2. These or similar general conclusions had been arrived at by previous experimenters; but I have been able to give a considerable series of actual measurements of the amount of action exercised by the various solutions upon given surfaces of lead under stated conditions.

3. In carrying out the experiments alluded to above I was often struck by apparent discrepancies in the results

A.—EXPERIMENTS CARRIED OUT IN CORKED FLASKS NEARLY FILLED WITH LIQUID, 500 cbc. IN EACH.

Nature of Solution.	Grms. per Litre.	Surfaces of Lead Exposed in sq. cm.	Total Lead in Milligrams. in Solution in the Liquid after—									
			42 hours.	68 hours.	70 hours.	138 hours.	140 hours.	168 hours.	336 hours.	340 hours.	505 hours.	
Distilled water	—	25	0.7	—	—	—	—	—	—	1.2	1.5	
" "	—	50	0.7	—	—	—	—	—	—	0.9	1.0	
" "	—	60	—	0.5	0.5	0.8	0.8	—	—	—	—	
" "	—	120	—	0.2	0.2	0.4	0.4	—	—	—	—	
Potassium nitrate	0.132	60	—	0.5	0.5	0.7	—	—	—	—	—	
" "	"	120	—	0.2	—	0.4	—	—	—	—	—	
" "	"	240	—	—	0.1	—	—	—	—	—	—	
" "	0.232	60	—	—	0.7	—	—	—	—	—	—	
" "	0.200	25	0.7	—	—	—	—	—	—	1.2	1.6	
" "	"	50	1.0	—	—	—	—	—	—	1.2	1.5	
Ammonium nitrate	0.200	25	0.9	—	—	—	—	—	—	1.8	1.8	
" "	"	50	1.4	—	—	—	—	—	—	1.5	1.5	
Calcium chloride	0.132	60	—	0.4	0.4	0.7	—	—	—	—	—	
" "	"	120	—	0.2	0.2	0.4	—	—	—	—	—	
" "	"	240	—	0.15	—	—	—	—	—	—	—	
" "	0.200	25	—	—	—	—	—	1.3	1.8	—	3.0	
" "	"	50	—	—	—	—	—	2.0	2.5	—	2.5	
" "	0.232	60	—	—	0.7	—	—	—	—	—	—	
Potassium carbonate	0.200	25	—	—	—	—	—	traces	0.3	—	0.3	
" "	"	50	—	—	—	—	—	"	0.3	—	0.3	
Ammonium sulphate	0.200	25	—	—	—	—	—	0.5	0.7	—	0.7	
" "	"	50	—	—	—	—	—	0.7	0.7	—	0.7	

B.—EXPERIMENTS CARRIED OUT IN BEAKERS HALF FILLED WITH LIQUID (500 cbc.) AND COVERED WITH UNSIZED PAPER; DIAMETER OF MOUTH OF BEAKER = 11.5 cm.

Distilled water	—	25	0.4	—	—	—	—	—	—	0.5	0.8	
" "	—	50	0.4	—	—	—	—	—	—	1.2	1.8	
" "	—	120	—	1.0	1.0	1.2	1.2	—	—	—	—	
" "	—	240	—	1.2	1.2	—	—	—	—	—	—	
Potassium nitrate	0.132	120	—	1.0	1.0	1.2	—	—	—	—	—	
" "	"	240	—	1.2	1.2	—	—	—	—	—	—	
" "	0.200	25	0.4	—	—	—	—	—	—	0.4	0.5	
" "	"	50	0.6	—	—	—	—	—	—	2.2	2.5	
" "	0.232	120	—	—	1.2	—	—	—	—	—	—	
Ammonium nitrate	0.200	25	0.4	—	—	—	—	—	—	2.0	4.0	
" "	"	50	0.8	—	—	—	—	—	—	3.5	4.0	
Calcium chloride	0.132	120	—	1.3	1.3	1.5	—	—	—	—	—	
" "	"	240	—	—	1.2	—	—	—	—	—	—	
" "	0.200	25	—	—	—	—	—	1.3	1.5	—	2.8	
" "	"	50	—	—	—	—	—	2.0	3.0	—	3.5	
" "	0.232	120	—	—	1.5	—	—	—	—	—	—	
Potassium carbonate	0.200	25	—	—	—	—	—	0.2	0.3	—	0.3	
" "	"	50	—	—	—	—	—	0.2	0.3	—	0.3	
Ammonium sulphate	0.200	25	—	—	—	—	—	0.7	1.0	—	1.3	
" "	"	50	—	—	—	—	—	0.7	1.0	—	1.5	

C.—EXPERIMENTS CARRIED OUT IN BASINS FULL OF LIQUID (500 cbc.) AND COVERED WITH UNSIZED PAPER DIAMETER OF MOUTH OF BASIN = 14.5 cm.

Distilled water	—	25	0.6	—	—	—	—	—	—	2.0	4.2	
" "	—	50	0.8	—	—	—	—	—	—	1.5	3.5	
" "	—	120	—	—	1.5	—	—	—	—	—	—	
Potassium nitrate	0.132	120	—	—	1.5	—	—	—	—	—	—	
" "	0.200	25	0.8	—	1.6	—	—	—	—	2.8	6.0	
" "	"	50	1.1	—	—	—	—	—	—	2.8	3.5	
Ammonium nitrate	0.200	25	1.0	—	—	—	—	—	—	8.0	16.0	
" "	"	50	1.3	—	—	—	—	—	—	10.0	16.0	
Calcium chloride	0.132	120	—	—	1.8	—	—	—	—	—	—	
" "	0.200	25	—	—	—	—	—	2.0	3.0	—	5.5	
" "	"	50	—	—	—	—	—	2.5	3.5	—	4.5	
Potassium carbonate	0.200	25	—	—	—	—	—	0.5	0.7	—	0.7	
" "	"	50	—	—	—	—	—	0.7	0.9	—	0.9	
Ammonium sulphate	0.200	25	—	—	—	—	—	2.5	9.0	—	16.0	
" "	"	50	—	—	—	—	—	2.5	7.5	—	12.0	

D.—EXPERIMENTS CARRIED OUT IN CORKED FLASKS NEARLY FILLED WITH LIQUID (500 cbc.) THROUGH WHICH A STREAM OF AIR WAS CONTINUALLY PASSED.

Nature of Solution.	Grms. per Litre.	Surfaces of Lead Exposed in sq. cm.	Total Lead in Milligrams. in Solution in the Liquid after—								
			42 hours.	68 hours.	70 hours.	138 hours.	140 hours.	168 hours.	336 hours.	340 hours.	505 hours.
Distilled water	—	25	—	—	—	—	—	—	—	1'5	2'0
Potassium nitrate	0'132	25	—	—	—	—	—	—	—	1'2	1'5
Calcium chloride	0'200	25	—	0'8	—	—	—	—	—	—	—
"	"	50	—	—	—	—	—	3'5	3'5	—	3'5
Potassium carbonate	"	25	—	—	—	—	—	0'5	0'5	—	0'5
"	"	50	—	—	—	—	—	0'4	0'6	—	0'6
Ammonium sulphate	"	25	—	—	—	—	—	0'5	0'5	—	0'5
"	"	50	—	—	—	—	—	1'3	3'0	—	5'0
"	"	50	—	—	—	—	—	0'7	1'3	—	2'5

E.—EXPERIMENTS CARRIED OUT IN BEAKERS HALF FILLED WITH LIQUID (500 cbc.) AND COVERED WITH UNSIZED PAPER: DIAMETER OF MOUTH OF BEAKER = 11'5 cm. THE LEAD WAS SUSPENDED IN THE LIQUID SO THAT AN AMOUNT OF SURFACE, EQUAL TO THAT IMMERSSED, WAS EXPOSED TO THE AIR.

Calcium chloride	0'200	25	—	—	—	—	—	1'4	2'5	—	3'5
"	"	50	—	—	—	—	—	2'1	3'5	—	4'0
Potassium carbonate	"	25	—	—	—	—	—	traces	0'2	—	0'3
"	"	50	—	—	—	—	—	0'5	0'7	—	0'7
Ammonium sulphate	"	25	—	—	—	—	—	0'8	1'5	—	2'5
"	"	50	—	—	—	—	—	1'0	2'0	—	3'5

obtained; hence I was led to the belief that the action of dilute saline solution upon lead is one which may be very materially altered by what appear at first sight to be slight alterations in the conditions of the action. The object of the experiments detailed in the present paper was, if possible, to determine more narrowly what these conditions are. The questions to which I shall endeavour at present to give answers, partial though they must be, are these:—Does the amount of lead dissolved increase with increase of surface exposed to the action of the solvent? Does the free admission of air to the surface, or the passage of air through the body of the liquid influence the quantity of lead dissolved? Do the solvent actions of dilute saline solution upon lead continue during lengthened periods, or is there a limit reached after which little or no further action is exercised upon the lead?

4. And, in the first place, does the amount of lead dissolved increase with increase of surface exposed to the action of the solvent? In order to obtain an answer to this question experiments were carried out with the same solvent, but with varying surfaces of lead exposed, and under somewhat varying conditions of action.

The results of these experiments are presented in Table I.

These results do not point to a regular increase of lead dissolved associated with increase of surface exposed. In certain cases the amount of lead dissolved does increase most notably as the surface exposed is increased, but in other cases it diminishes. The other conditions affecting the solvent action appear to exercise a disturbing influence upon that one condition, the action of which it was desired to trace. Thus in the case of distilled water, whether the surface of lead exposed measured 25 or 50 sq. cm. when the action was allowed to proceed for 42 hours, the amount of lead dissolved was the same, nor did carrying out the experiment in a corked flask, a beaker, or a basin loosely covered with porous paper, materially affect the result. But when the action had proceeded for 340 hours, the conclusions to be drawn are found to be very considerably affected by the nature of the vessel employed. In closed flasks the amount of lead dissolved slightly decreased with increase of surface exposed; in beakers there was a very marked increase in lead dissolved with increase of surface exposed, while in basins again increase of surface was associated with decrease of solvent action. By looking at the experiments carried out in corked flasks I think it would be altogether unwarrantable to say that an increase of surface exposed is generally associated with an increase in quantity of lead dissolved. From the experiments carried out in beakers half filled

with liquid and covered with porous paper I think the conclusion may be deduced that there is *generally* an increase of solvent action with increase of exposed surface; this is especially evident in the case of those salts which increase the solvent action (nitrates, &c.) and after the lapse of considerable periods of time—300 to 500 hours. The results of the experiments carried out in basins do not permit me to draw any general conclusion on the subject now under consideration; there is sometimes an increase, at other times a decrease, in the amount of lead dissolved associated with a fixed increase in surface exposed. It would almost appear as if exposure of the liquid to large surfaces of air was less fitted to promote solvent action than exposure to smaller surfaces of air. And the experiments carried out in flasks through which a stream of air continually passed seem to countenance some such conclusion as this. In these experiments there was invariably a diminution in the quantity of lead dissolved associated with an increase in the surface exposed. It is only in the last set of experiments carried out in beakers half filled with water, and loosely covered, and having one half of the lead immersed in the liquid and the rest exposed to the air—that an increase in lead dissolved is invariably associated with increase of surface exposed. So far as the first inquiry is concerned these experiments do not warrant the assumption of an invariable increase in the quantity of lead dissolved associated with an increase in the surface of lead exposed to the action of the solvent.

(To be continued.)

NOTICES OF BOOKS.

Practical Portrait Photography, &c. By WILLIAM HEIGHMAN. London: Piper and Carter.

THIS little work would have been a much more satisfactory performance had the author recollected its title and confined himself entirely to the manipulatory portion of photography, which he has treated capitally, instead of constantly interlarding his practical directions with *dicta* on the chemistry of the subject, which only serve to show once more that "a little learning is a dangerous thing." Mr. Heighman is evidently an expert manipulator who has pursued photography much more as an art than a science: hence his descriptions of the various processes and his remarks on the artistic part of the matter are all that can be said. The chapter on "Photographic

Æsthetics," "Expression," "Pose," "Illumination," and "Retouching," might be studied with advantage by many even of our first-class photographers, who are only too frequently deficient in artistic taste and feeling. With this part of the book, however, we have but little concern.

The numberless formulæ published in the columns of our photographic contemporaries, which are generally the invention of some enthusiastic amateur who wants to make his name famous, have long since become so bewildering to the professional photographer who is desirous of improving his art to the utmost, that a work like the present, giving new and tried recipes, will be warmly welcomed by him. The practical worker now-a-days has no time for trying experiments; the consequence is that a new formula or the improvement of an old one is quite a rarity in the annals of photography. These remarks apply with still greater force to the amateur, who, as a rule, is too much given to run after worthless novelties in the way of sensitising baths and developing solutions. Mr. Heighman's remarks on precision and cleanliness will be found most valuable to all classes of photographers. The author himself is apparently excessively precise and cleanly in manipulation, and we question whether some of his methods would succeed with the hurried professional or careless amateur. His recommendation to coat the glass plate with ammoniated albumen before coating it with collodion would, we fear, prove a failure in most cases. With great perfection of manipulation, no doubt, the albumen and ammonia will not injure the silver-bath, but perfection is not attained by everybody. The arrangement of the dark room is more fully dwelt upon than in most manuals of the kind, but the directions for doctoring spoilt and worn-out baths are too complicated for general practice. An odd omission, too, occurs in the remedy for a too acid bath. Liquor ammoniæ is to be dropped in until a black precipitate is formed, but nothing is said about subsequent filtration and acidification, without which the bath would be distinctly alkaline. In the directions for making a negative bath the learner is told to dissolve silver nitrate in water, to iodise it in the usual manner, after which it is to be filtered and made alkaline with liquor ammoniæ; it is then exposed to the sunlight, when it deposits "organic matter as thick mud at the bottom of the bottle!" May we ask Mr. Heighman whence this organic matter comes? At page 22 the author states that "the effect of acid in the bath is to decompose any organic matter present in the solution," whereas at page 28 he says that "acid holds the organic matter in solution." Surely Mr. Heighman's ink must have been strongly alkaline when he wrote this portion of his manual.

The style of the book is, to say the least of it, eccentric. "Graduate" for graduated measure, "flow" for pour or coat, and "skylight" for glass room, are certainly not Queen's English. We hope to see another edition of this really useful work, but divested of all such defects as we have pointed out. There are also several misprints that ought to be corrected, such as "hyposulphate" for "hyposulphite," "liquor ammonia" for "ammonia."

The Journal of the Iron and Steel Institute, 1876. London: E. and F. N. Spon.

This issue contains the respective discussions on Mr. Sandberg's paper on "The Strength of Rail Joints," and on Mr. Snelus's paper on "Fire-Clays and other Refractory Materials." In this latter much weight was laid on the importance of an accurate determination of potash and soda, the constituents which mainly imparted a fusible character to clays. There is also a discussion on the "Use of Molten Iron Direct from the Blast-Furnace for Bessemer Purposes;" and papers on the "Uses of Ferro-Manganese," by M. F. Gautier, of Paris; on the "Ferrous Rock Drill and Air Company," by Mr. H. W. Pendred; and on "Carbon and other Deposits from the Gases of Blast-Furnaces in Cleveland," by Mr. J. Pattinson. It appears that the fire-brick lining of certain

blast-furnaces, even in the upper part, was strikingly disintegrated. On analysis it was found that carbon had been deposited within the texture of the bricks to the extent of from 2.05 to 5.97 per cent, whilst the proportion of potash present, amounting to 2.60 per cent in the original brick, was increased in one case to 7.54 per cent.

The issue further contains papers on the "Casson-Dorney Puddling Furnace," by Mr. E. F. Smith; on "Cleveland Steel Rails;" on "Overcoming Steep Gradients on Railways," by Mr. H. Handyside; "Notes on Iron-Ore Deposits at Naeverhaugen, Bodø, Norway," by Mr. Thorsten Nordenfelt; on "Improved Casting Arrangements for the Siemens-Martin Process," by Mr. Michael Scott; together with "Reports on the Progress of the Iron and Steel Industries in Foreign Countries and in the United Kingdom."

CORRESPONDENCE.

THE SOCIETY OF PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—The time has arrived when those members who, like myself, consider that the present editorship is compromising the Society of Public Analysts have to choose between making a change in the editorship and retiring from the Society. The irregularities in the Society, and the want of vitality shown by the scantiness of the attendance at the ordinary meetings, and by other unmistakable signs, discourage the effort to attempt a reformation, and, following the example of our Treasurer, I am adopting the easier course of retiring from the Society. I have laid down my office of Vice-President, and ceased to be a member of the Society of Public Analysts.—I am, &c.,

J. ALFRED WANKLYN.

117, Charlotte Street, Fitzroy Square, London, W.
November 18, 1876.

THE D-LINES SPECTRA FLAME EXAMINED BY THE BLOWPIPE.

To the Editor of the Chemical News.

SIR,—The communications of your contributor, Major Ross, are—so often as they are confined to the subject of "Pyrology"—sometimes interesting, and always amusing. But it does not seem to occur to Major Ross that when they treat of subjects "external to the pyrocone," they are not brilliantly caudescant, and that they may, besides, do positive harm. For it is not impossible to suppose that among the readers of the *CHEMICAL NEWS* there may be numbered some who may think that, notwithstanding the accumulated evidence to the contrary, Major Ross has raised a reasonable doubt that the D-lines in the spectrum are produced, not by sodium, but by water, and that the series of experiments which he adduces in proof are a fair specimen of the experimental method as followed by chemists; and if this be so, it may be desirable to point out—(1) That at a "white heat" the sodium salt adherent to platinum wire or foil is readily volatilised, and soon fails to afford the spectrum characteristic of sodium, while at a lower temperature—the salt being less volatile—the spectrum is more permanent. (2) That the absorption of an orange flame (*sic*) by fused boracic acid, and the consequent opacity of the latter, is not positive evidence of the absence of sodium in that flame.

But Major Ross, who writes as if he really believed in his own theory, will hardly, I think, gain many co-believers among scientific men unless he can demonstrate that—(a) A vacuum tube containing sodium on platinum points will not, on the passage of an electric spark, give the D-lines unless it also contains water; and (b) that water which he can prove to be free from sodium will give them

Before writing this I have taken great pains to understand Major Ross's paper, and I could almost say that I do so were it not for the sentence which occurs at the end of his fifth paragraph. But here I frankly admit I have failed. After experimenting upon all the known relations of "that that" to "this," and of "that this" to "that" by analysis and synthesis (and, I had almost said, the "sodium hypothesis"), I have been obliged to abandon the problem.—I am, &c.,

NaHO.

ON ANTHRACENE TESTING.

To the Editor of the Chemical News.

SIR,—Mr. Caspers' remarks on my investigation on anthracene testing require my immediate reply.

Mr. Caspers is guilty of a singular want of tact, by first obtaining from me private information, and an exceptional sample of anthracene, and then utilising the same in contradicting my statements, without informing me of his intention to do so. Such conduct is happily unknown in the scientific world, or there would soon be an end of all free exchange of ideas on scientific matters. But Mr. Caspers is no chemist, and I cannot discuss with him theoretical questions: his observations on my results are valueless.

Mr. Caspers, with charming simplicity, shows his ignorance of the first rudiments of chemistry when he says—"Nearly all coal-tar distillers, even those who work under the direction of efficient chemists, have unpersuadably to believe that the *specific gravities* of quinone and anthracene are in proportion like 1000 : 856."

Apart from the mass of confused ideas compressed into a few lines, the fact clearly stands out that the writer does not know the difference between specific gravity and atomic weight, and I must simply decline to notice any future criticisms coming from such doubtful authority.—I am, &c.,

FREDERICK VERSMANN.

35, Whitecross Place, Wilson Street,
Finsbury, E.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 19, November 6, 1876.

Researches on the Production of Electro-Chemical Deposits of Aluminium, Magnesium, Cadmium, Bismuth, Antimony, and Palladium.—M. A. Bertrand.—The author has obtained deposits of aluminium on decomposing with a strong battery a solution of the double chloride of aluminium and ammonium. A plate of copper, forming the negative pole, whitens gradually, and becomes covered with a layer of aluminium, which takes a brilliant polish under the burnisher. The double chloride of magnesium and ammonium in an aqueous solution is readily decomposed by the battery, giving in a few minutes strongly adherent and homogeneous deposits of magnesium upon a sheet of copper. It polishes readily. The battery must be powerful. Cadmium is best deposited from the bromide to which a little sulphuric acid has been added. It is then very coherent and very white, and takes a fine polish. The sulphate, if acidulated, also gives an immediate deposit of metallic cadmium, very adhesive, and capable of a fine polish. Bismuth is deposited from a solution of the double chloride of bismuth and ammonium upon copper or brass by the current from a Bunsen ele-

ment. It is very adhesive; though mat, it is capable of taking a fine polish, and may be introduced in the decoration of objects of art. Antimony can be deposited from a solution of the double chloride of antimony and ammonium at common temperatures. It frequently serves to replace platinum-black in a number of fine art manufactures. Deposits of palladium are obtained with ease by means of the double chloride of palladium and ammonium, either with or without the battery. The solution must be perfectly neutral.

New Dynamo-Magnetic Phenomenon.—MM. Trève and Durassier.—Let there be a horse-shoe magnet, of any length, covered upon one side with varnish, or, better, with a plate of glass. If there is laid upon the neutral part a cylinder of soft iron, it is seen to move towards the poles, which it reaches in a time which is a function of the weight of the cylinder and of the coercitive force of the magnet. Hence there results a new method of estimating the magnetic force by the mechanical work which it effects.

Detection of Magenta in Wine.—M. E. Bouillon.—Five hundred c.c. of wine are placed in a capsule, raised to a boil, and evaporated down to 125 c.c.; the capsule is then withdrawn from the fire, and 20 grms. crystalline hydrate of baryta are added. It is agitated to facilitate the reaction, allowed to cool, poured upon a filter, and the precipitate washed with distilled water, so as to obtain in all 125 c.c. of filtrate. It is then necessary to ascertain, by the addition of a few crystals of hydrate of baryta to the filtered liquid, that the precipitation of the colouring matter of the wine is complete: if not, more hydrate of baryta must be added, and the liquid re-filtered. It is then introduced into a flask containing about 250 c.c., with 50 to 60 c.c. of pure ether, strongly shaken, and allowed to settle. When the ether is completely separated from the aqueous liquids it is drawn off by means of a pipette, and poured into a porcelain capsule. A drop of acetic acid at 8° is added, 3 or 4 drops of distilled water, and a little white unwoven silk, consisting of ten threads a centimetre in length. If the quantity of magenta contained in the wine is at all notable acetic acid produces at once a rose colouration, but when only minute traces are present the ether is allowed entirely to evaporate. The residue consists of a small quantity of aqueous liquid, in which the silk soaks. The capsule is then very gently heated, so as to evaporate the bulk of this liquid, and concentrate the traces of colouring matter in a few drops, thus favouring its fixation upon the silk. This process, if carefully executed, reveals one hundred-millionth part of magenta in wine.

Reimann's Farber Zeitung.
No. 39, 1876.

Pittakall is manufactured by a company in Hanover under the name of violacein.

The use of vanadic aniline-blacks is greatly on the increase in France. The colour obtained is fast, both as against milling and acids.

Mahogany is again recommended as a dye-ware. The shades obtained are reported to resemble the colour of the wood itself, and to be very fast. The mordants used are acetate of alumina for cotton, and sulphates of iron and copper for wool.

MISCELLANEOUS.

Organisation Among Chemists.—The adjourned meeting to discuss this subject assembled in the Chemical Society's Room, Burlington House, on Saturday, November 4th, 1876. Prof. F. A. Abel, F.R.S., President of the Chemical Society, in the Chair. The minutes of the previous meeting were read and confirmed. The

Report of the Committee appointed to confer with the Council of the Chemical Society was read. It was proposed by Mr. J. A. Wanklyn and seconded by Prof. Redwood:—"That the cordial thanks of the meeting be tendered to the President and Council of the Chemical Society for the consideration given by them to the proposals of the Organisation Committee, and for the efforts made by them to meet the views of the Committee in relation to these proposals." (Carried unanimously.) It was proposed by Prof. Frankland, F.R.S., seconded by Dr. Voelcker, F.R.S., and supported by Dr. Williamson, F.R.S.:—"That, having regard to the limited powers of the Chemical Society under its charter, it is desirable that an Association be formed that shall be independent of the Chemical Society, and that the Organisation Committee already formed be dissolved, and that the following gentlemen, or such of them as may be willing to act, form a new Committee (with liberty to add to their number) to settle the form and details of the scheme, and to take all steps necessary to secure the formation and incorporation of the proposed new Association." (Carried unanimously.) The proposed Committee are the following:—Prof. Abel; Mr. A. H. Allen (Sheffield); Dr. H. E. Armstrong; Prof. Atfield; Mr. James Bell; Mr. I. Lowthian Bell (Middlesbrough); Prof. Bloxam; Prof. Crum Brown (Edinburgh); Mr. M. Carteighe; Mr. Dugald Campbell; Mr. W. Crookes; Mr. G. E. Davis (Runcorn); Dr. Dupré; Prof. James Dewar (Cambridge); Mr. F. Field; Mr. R. J. Friessell; Prof. Frankland; Prof. Gladstone; Mr. George Gore (Birmingham); Prof. Galloway (Dublin); Mr. C. E. Groves; Mr. W. N. Hartley; Mr. C. W. Heaton; Mr. Douglas Hermann (St. Helens); Mr. David Howard; Mr. C. T. Kingzett; Prof. Marréco (Newcastle); Mr. F. A. Manning; Dr. E. J. Mills; Dr. Hugo Müller; Mr. E. Neison; Prof. Odling (Oxford); Mr. F. J. M. Page; Mr. J. Pattinson (Newcastle); Dr. B. H. Paul; Mr. W. H. Perkin; Mr. C. H. Piesse; Prof. Redwood; Prof. Emerson Reynolds (Dublin); Dr. W. J. Russell; Dr. R. Angus Smith (Manchester); Dr. H. Sprengel; Dr. Stevenson; Mr. R. Tatlock (Glasgow); Mr. E. T. Teschemacher; Prof. R. V. Tuson; Dr. Voelcker; Mr. J. A. Wanklyn; Prof. Williamson; Mr. J. T. Way; Dr. C. R. A. Wright. A vote of thanks to the Chairman (Prof. Abel) for presiding was carried by acclamation, and a vote of thanks to the Secretaries terminated the proceedings. The majority of the gentlemen whose names have been proposed have agreed to aid in forming the Institution.

New Work by Professor Hayden.—An important work is now being issued by Prof. F. V. Hayden, whose name is a sufficient guarantee of its scientific value. The title is "The Yellowstone National Park and the Mountain Regions of Portions of Nevada, Idaho, Colorado, and Utah," by Prof. F. V. Hayden, Geologist-in-charge of the U.S. Government Expeditions to the Yellowstone Valley of the years 1871 and 1872, and of the U.S. Geological and Geographical Survey of the Territories. The work is illustrated by chromo-lithographic reproductions of water-colour sketches taken by Thomas Moran. The price for the complete work, 5 parts, with text, is 50 dollars. The text will be published simultaneously in English, French, and German. The list of plates includes Hot Springs of Gardiner's River, Yellowstone National Park; The Great Blue Spring of the Lower Geyser Basin, Yellowstone National Park; The Castle Geyser—Upper Geyser Basin, Yellowstone National Park; Lower Yellowstone Range, Yellowstone National Park; Yellowstone Lake, Yellowstone National Park; Tower Falls and Sulphur Mountain, Yellowstone National Park; Head of Yellowstone River, Yellowstone National Park; The Grand Canon, Yellowstone, Yellowstone National Park; The Towers of Lower Falls, Yellowstone National Park; The Mountain of the Holy Cross; The Mosquito Trail, Rocky Mountains of Colorado; Summit of the Sierra Nevada; Great Falls of Snake River; Valley of Babbling Waters, Southern Utah; The Great Salt Lake of Utah.

MEETINGS FOR THE WEEK.

MONDAY, 27th.—Royal Geographical, 8.30.
— Medical, 8.
— Society of Arts, 8. Cantor Lectures.
TUESDAY, 28th.—Civil Engineers, 8.
— Anthropological Institute, 8.
— Manchester Literary and Philosophical Society, 7.
WEDNESDAY, 29th.—Society of Arts, 8.
THURSDAY, 30th.—Royal, 4. (Anniversary.)
FRIDAY, Dec. 1st.—Geologist's Association, 8.
SATURDAY, Dec. 2nd.—Physical, 3. "On some Mechanical Illustrations of Thermo-Electric Phenomena," by O. J. Lodge, B.Sc.

TO CORRESPONDENTS.

J. J. L.—We should think there is alum in the paste.
G. M.—The part of the Report to which you refer has not yet appeared in our columns.
R. L.—Dr. Versmann's letter renders the publication of your's unnecessary.
ERRATUM.—Page 212, col. 1, line 3 from top for "250° C." read "275° C."

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WM. NICHOLS MARCY,
Clerk of the Peace.

County Hall, Worcester,
November 15, 1876.

Wanted, a Chemist thoroughly accustomed to the testing required in an Alkali Works. State salary required.—Address, M. N., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

THE CHEMICAL NEWS.

VOL. XXXIV. No. 888.

ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 220).

101. THE difficulty which attended experiments with the balances and bulb apparatus used at first was to bring the moving part accurately back to zero, and also to measure the deflection produced. I therefore tried several plans of giving a fixed zero-direction to the movable index. Thus a piece of magnetic oxide of iron was cemented to one end of the index, and a permanent magnet was brought near it. This answered pretty well, but was inconvenient, besides not being sufficiently accurate. A bifilar suspension from cocoon-fibres seemed likely to succeed better; but the difficulty of suspending the rod in this manner, so as to get exactly the same tension on each fibre, was very great, and unless this was done there was more tendency to move in one direction than in the other. When I had succeeded in suspending the needle with an equal tension on each silk fibre, I found their elasticity to vary; and as soon as the vacuum was approached one was sure to contract more than the other, twisting the needle out of the axis of the tube, and sometimes causing it to touch the side. This method of suspension was therefore abandoned.

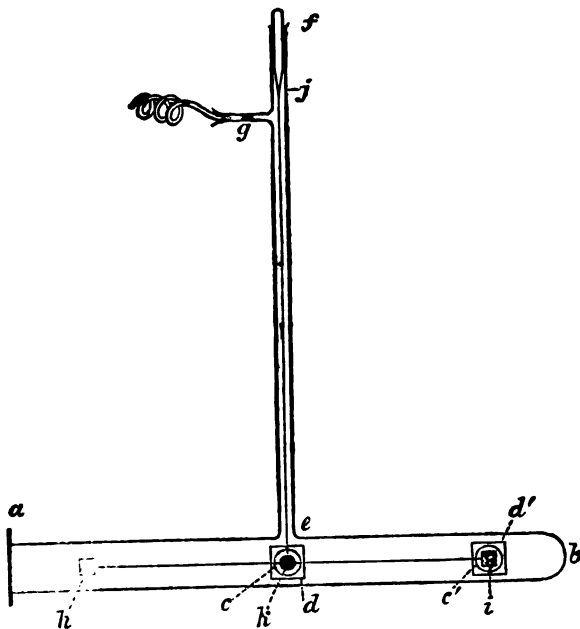
By increasing the length of the needle, and also of the fibre used to suspend it, it was possible to employ fibres with a considerable amount of torsion, and still preserve the delicacy of the apparatus. Fine platinum wire was first tried; but this was soon abandoned in favour of glass fibres, which were found to answer so perfectly that I have since used nothing else.

102. Fig. 7 shows the form of apparatus which I have finally adopted, as combining the greatest delicacy with facility of obtaining accurate observations, and therefore of getting quantitative as well as qualitative results. It is a torsion apparatus in which the beam moves in a horizontal plane, and may be called a horizontal torsion balance. *ab* is a piece of thin glass tubing, sealed off at the end *b* and ground perfectly flat at the end *a*. In the centre a circular hole, *c*, is blown, and another one, *c'*, at the end; the edges of these holes are ground quite flat. *a*, *c*, and *c'* can therefore be sealed up by cementing flat transparent pieces of plate glass, quartz, or rock-salt, *a*, *d*, and *d'* on to them (83). To the centre of *ab* an upright tube, *ef*, is sealed, having an arm, *g*, blown on to it for the purpose of attaching the apparatus to the pump. *hi* is a glass index, drawn from circular or square (22) glass tube, and as light as possible consistent with the needful strength. A long piece of this tube is first drawn out before the blowpipe; and it is then calibrated with mercury until a piece is found having the same bore throughout: the necessary length is then cut from this portion. *jk* is a very fine glass fibre, cemented at *j* to a piece of glass rod, and terminating at *k* with a stirrup, cut from aluminium foil, in which the glass index, *hi*, rests. In front of the stirrup is a thin glass mirror, shown at *k*, silvered by Liebig's process, and either plane or concave as most convenient. At the ends of the glass index (*hi*) may be cemented any substance with which it is desired to experiment; for general observations I prefer to have these extremities of pith, as thin as possible, and exposing a surface of 10 millimetres square. The pith may be coated with lampblack or silver, or may retain its natural surface.

103. The preparation of the suspending thread of glass

requires some care. It should be drawn from flint glass, as this gives much tougher threads than foreign glass. The diameter varies with the amount of torsion required; it may be 0.001 inch or less. I select the piece best adapted for the special experiment in the following way:—Several threads of glass are first drawn out before the blowpipe, and a certain number selected as being likely to answer the purpose. These are then suspended side by side to a horizontal rod and equalised as to length. A piece of glass rod, about 2 inches long, which is always kept for this purpose, is then cemented by shellac on to the end of one of the threads. Air currents are then cut off by a glass screen, and the thread being set in movement by a slight twist, the torsion is measured by timing the oscillations. This having been done with each thread in succession, one is selected and mounted in the apparatus. If it works properly, well and good; if not, it is easy to select a thread having the requisite amount of torsion, more or less, and substitute it for the one first used.

FIG. 6.



In fitting up one of these apparatus threads were drawn out which were found to require, respectively:—

44 seconds,

30 "

28 "

11 "

and

3½ "

for a half oscillation when the glass weight was hung on to their ends. The one oscillating in 30 seconds was first used, but was found to give insufficient torsion. The one making half an oscillation in 11 seconds was then used, and was found to answer well. Before I adopted this plan days were frequently wasted in the attempt to hit upon a glass thread of the requisite degree of fineness.

104. In taking accurate observations with an apparatus of this description, it is necessary to support it on a stand firmly fastened to a main wall. When resting on a bench, or connected in any other way to the floor, there is a constant oscillation which keeps the index from zero.

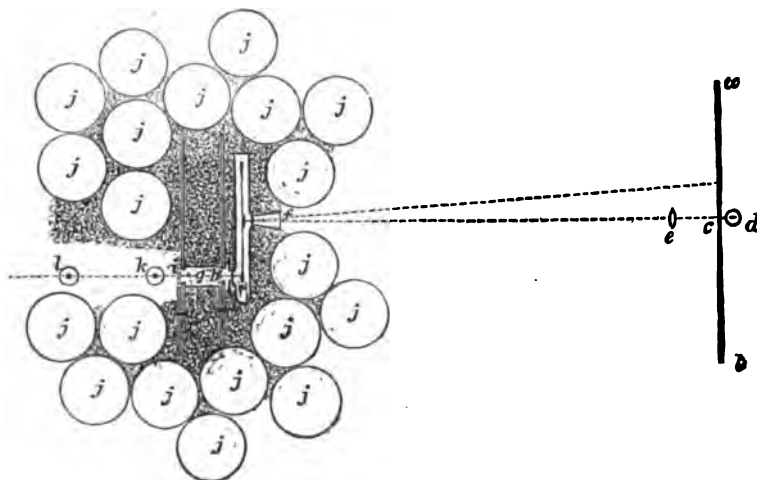
The apparatus being fastened firmly to its stand, accurately levelled, and sealed on to the pump, a divide scale, *ab* (fig. 8), is placed four feet from the small mirror; and immediately beneath the scale is a narrow brass slit

c, illuminated by a lamp, *d*. In front is a lens, *e*, which throws the image of the slit on to the mirror, where it is reflected back again on to the divided scale. Here the angular movement of the bright line of light shows the

for some weeks, as the residual moisture in the pith^w then have been absorbed by the sulphuric acid in the pump.

(To be continued.)

FIG. 8.



minutest attractive or repulsive force acting on the pith at the extremity of the movable index.

In order to keep the luminous index accurately at zero, except when experiments are being tried, extreme precautions must be taken to keep all extraneous radiation from acting on the apparatus. A slightly conical paper tube, *f*, about 6 inches long, and as narrow as the angular movement of the ray of light will admit of, is cemented on to the glass window in front of the mirror; and a similar tube, *g*, is cemented on to the quartz window in front of the pith surface on which radiation is to act. The latter tube is furnished with card shutters, *h, i*, at each end, capable of easy movement up and down. The whole apparatus is then closely packed on all sides with a layer of cotton-wool, about 6 inches thick, and outside this is arranged a double row of Winchester quart bottles, *j, j*, filled with water and covered with brown paper, spaces being only left in front of the paper tubes. *k* and *l* represent the positions of the candle 140 and 280 millims. distant from the pith. The whole arrangement has the appearance shown in fig. 8.

105. I will not discuss at present the phenomena presented when the apparatus is full of air, or when the vacuum is imperfect, but will proceed to the effects observed when the exhaustion has been pushed to the highest attainable degree. However much the results may vary when the vacuum is imperfect, or when the apparatus is full of air, I always find them agree amongst themselves when the residual gas is reduced to the minimum possible; and I have also ascertained that it is of no consequence what this residual gas is. Thus I have started with the apparatus filled with various vapours and gases, such as air, carbonic acid, water, iodine, hydrogen, or ammonia; and at the highest rarefaction I find no difference in the results which can be traced to the residual vapour, assuming any to be present. A hydrogen vacuum seems neither more nor less favourable to the phenomena than does a water or an iodine vacuum. If moisture be present to begin with, it is necessary to allow the vapour to be absorbed by the sulphuric acid of the pump, and to continue the exhaustion with repeated warming of the apparatus until the aqueous vapour is removed; then only do I get the best results. When pith surfaces are used at the extremities of the glass beam, they should be perfectly dry; and they are more sensitive if the apparatus has held a vacuum

NEW PROCESS FOR TITRATING ASTRINGENT SUBSTANCES.

By M. FERDINAND JEAN.

WHEN we pour drop by drop a solution of iodine into any decoction of an astringent matter, previously mixed with an alkaline carbonate, we remark that this solution is absorbed with a great energy. I have observed that the absorption of the iodine takes place, in these conditions, in the direct ratio of the quantity of astringent matter taken, and that 1 part by weight of tannic acid absorbs 4 parts of iodine before we can observe the presence of free iodine in the liquid. It is on this action of iodine on astringent matters that the process of titration is based which forms the subject of this note. The solution of iodine necessary for titrating tannin is obtained by dissolving in iodide of potassium 4 grms. of iodine, and adding to the solution distilled water in quantity sufficient to make a volume of 1000 c.c. To ascertain the value of the solution of iodine, we introduce into a beaker 10 c.c. of a solution of tannin at 0.1 grm. per cent; we mix it with 2 c.c. of an alkaline lye containing 25 percent of crystallised carbonate of soda; then, by the aid of a graduated burette, we cause to fall into the alkaline liquid the solution of iodine until a drop of the mixture, taken with the glass stirrer and put on a leaf of starched paper, produces a light violet spot, which indicates the presence of free iodine and the end of the operation. The value thus obtained must be corrected, that is to say we must deduct from the number of cubic centimetres of the solution of iodine corresponding to 0.01 grm. of tannin, the volume of this solution, which it is necessary to employ as pure loss before obtaining a coloured reaction on starched paper. For this purpose we measure 10 c.c. of distilled water, which is mixed with 2 c.c. of the alkaline solution; then we pour drop by drop the solution of iodine until we obtain a spot on the starched paper. With a solution of iodine, containing 4 grms. iodine per litre, the correction is commonly from 0.1 c.c., but the greater or less purity of the carbonate of soda may perhaps affect this correction very slightly. For 0.01 grm. of tannic acid dissolved in 10 c.c. of water we must generally use 10.5 c.c. of the solution of iodine at 4 per thousand. Under the influence of iodine the alkaline solutions of tannin, even diluted, take a colouration so intense that it

would not be possible to seize distinctly the colouration of iodide of starch if we added starch paste to the tanniferous liquid. This is why I have recourse to a leaf of white filter paper, which I cover by friction with a slight layer of powdered starch. The spots made on this paper with half a drop of liquor containing traces of free iodine are immediately absorbed and show the characteristic violet colouration, even when the liquid is deeply coloured. When the value of the solution of iodine is established with respect to a known weight of pure tannic acid, this test liquor may be employed to titrate the various astringent matters, if we adopt, as the authors of the processes for the determination of tannin hitherto published have done, tannic acid as the type of the active principle of astringent matters. But, if we wish to make very exact researches, it is necessary for each variety of astringent matter to be studied to ascertain the value of the solution of iodine by means of the pure astringent principle; for example, catechuic acid for catechu-moritanic acid for fustic; for the solution of iodine acts, without doubt, like other reagents in different proportion upon divers tannic acids. The tannic acid which I employ to establish the value of the solution of iodine is obtained by keeping the tannin of Pelouze at 80° in the water-bath. At this temperature a portion of tannin, about 42 per cent, melts, agglomerates into a greyish spongy mass, which contains the impurities of the tannin with the resins; the pulverulent part constitutes pure tannin and 10.5 c.c. of the solution of iodine at 4 per thousand correspond to 0.01 grm. of this tannin, whilst only 9.3 of the solution of iodine are required to saturate 0.01 grm. of the gummy matter. The titration of tannin by means of the solution of iodine being very rapid and very exact, I determined to apply it to the assay of natural astringent matters. For this purpose I had to ascertain whether the matters which accompany the tannin in vegetable extracts are without action on the solution of iodine. For this purpose I exhausted with 100 c.c. of distilled water 15.15 grms. of oak bark, which, assayed according to Hœner's process, contained 6.5 per cent of matter fixable by hide, and I performed in 10 c.c. of this decoction, containing consequently 0.01 grm. of tannin matters, the titration with a solution of iodine of which 10.5 c.c. corresponded to 0.01 grm. of pure tannic acid. If the extractive matters which accompany the tannin had acted on the solution of iodine I should have had to employ more than 10.5 c.c. of this solution; but in three assays I obtained the coloured reaction on starched paper. After having poured 9.8 c.c. of the solutions of iodine, I found then 5.92 c.c. per cent of tannin instead of 6.5 c.c., the value found in using Hammer's process. The discrepancy of 0.58, which the two processes give, must be attributed to the colouring matters which have been fixed by the hide along with the tannin in the assay by Hammer's process. In a second experiment I treated the same decoction of oak bark with an excess of powdered hide, and having separated by filtration the hide charged with tannin, I obtained, with 10 c.c. of the filtered decoctions, the reaction upon the starched paper after having employed 1.7 c.c. of the solution of iodine; whilst before the action of the hide it would be necessary to employ 9.8 c.c. But these 1.7 c.c. of solution of iodine, corresponded to 1.02 per cent of gallic acid, the average quantity of this acid, which has been remarked in French barks. Finally a decoction of oak bark was precipitated by acetate of copper. The tannate and the gallate of copper were separated by filtration, the filtered liquid was neutralised by carbonate of soda, then filtered anew to separate carbonate of copper. 10 c.c. of the clear solution, after an addition of 2 c.c. of a lye of carbonate of soda, only required 0.1 c.c. of the solution of iodine to produce a coloured reaction upon starch. This result shows very clearly that the extractive matters do not act on the solution of iodine, since we have only employed of this solution the volume which would have been necessary if we had operated upon distilled water, and nevertheless the liquor separated from

the gallate and the tannate of copper contained all the extractive matters, save a small quantity of brown acids which the acetate of copper had precipitated. Having shown that in the decoction of oak bark it is only tannic and gallic acids that absorb the solution of iodine, the process of titration that I propose may be employed with all safety for the assay of tanniferous matters. I have found that crystallised gallic acid decomposes the solution of iodine exactly in the same ratio as tannic acid. If then we wish to determine separately the gallic and tannic acid, we must determine at first the volume of the solution of iodine corresponding to the two acids jointly; then, after having separated the tannic acid by powdered hide, titrate the gallic acid remaining in solution. On deducting from the volume of the solution of iodine corresponding to the two acids that which belongs to gallic acid alone, we obtain the quantity of tannic acid,—*Bulletin de la Société Chimique de Paris.*

ESTIMATION OF POTASSIUM AS ACID TARTRATE.*

By P. CASAMAJOR.

IN most cases which present themselves to the chemist, in which potassium is to be estimated, it is accompanied by sodium, and the course usually pursued is to estimate the potassium directly as platino-potassic chloride. The precipitate obtained has the advantage that its weight is very great when compared to the weight of potassium in combination. There are difficulties, however, connected with the process, and there are cases in which it is not applicable without elaborate preparation; but platinic chloride, although expensive, is an excellent reagent, and, in experienced hands, very good results are obtained by its use.

Indirect processes are also in use, one of which consists in combining potassium and sodium with either chlorine or sulphuric acid, and in estimating the total quantity of salts by one operation and the quantity of either chlorine or sulphuric acid by another operation. From these two quantities the potassium and sodium can be calculated. Very good results are also obtained by this process.

There is also a very curious indirect process due to Gay-Lussac, to which I call your attention because I believe that it is not generally known, and because it presents a singular example of the expedients to which chemists have resorted to estimate potassium in presence of sodium. This process, which was in use some years ago in French saltpetre works, and may still be in use, is based on the following facts:—When 50 grms. of pure chloride of potassium are dissolved in 200 c.c. of water, the temperature of the liquid falls 11.4° C. If we take 50 grms. of chloride of sodium the fall of temperature will be only 1.9° C. Gay-Lussac has directed that the glass vessel in which the solution takes place should weigh 185 grms.—a point of some importance, as the vessel must acquire the temperature of the liquid it contains. To test a mixture of potassium and sodium salts they are brought, in the first place, to the state of chlorides and dried, and 50 grms. of the mixture are taken and dissolved in 200 c.c. of water. A decrease of temperature is noted, and the proportions of potassium and sodium chlorides are obtained from a table in which these proportions are placed, opposite numbers indicating the decrease of temperature. If this table is not at hand, the quantity of potassium chloride in 100 parts of the mixture may be found by calling the percentage of chloride of potassium x , and the decrease of temperature, in degrees C., d . Then $100 - x$ will be the percentage of sodium chloride, and we shall have—

* Read before the American Chemical Society, September 7, 1876.

$$100 d = 11.4 x + 1.9 (100 - x)$$

$$100 d = 11.4 x + 190 - 1.9 x$$

$$100 d = 9.5 x + 190$$

$$\text{whence—} \quad x = \frac{100 d - 190}{9.5}$$

My purpose this evening is to describe a process for the estimation of potassium as acid tartrate,—a process which has the advantage of being direct, and which gives results much more rapidly than can be obtained by any other means, while for accuracy they compare favourably even with those obtained by platinic chloride.

The occasion which led me to estimate potassium as acid tartrate was a series of experiments on the process of Messrs. Duncan and Newlands for separating potassium from the low products of sugar-houses by the addition of sulphate of alumina, and the consequent production of potassium alum. To avoid an excess of sulphate of alumina, which would be a waste, it became necessary to ascertain the quantity of potassium in each batch of products. For this determination platinic chloride is not very well adapted, as the first requisite was celerity rather than accuracy. The use of platinic chloride requires, in the first place, a thorough destruction of the organic matter by heat. The ashes, obtained as sulphates, are treated, in the next place, by an excess of barytic chloride, which gives a solution containing the chlorides corresponding to the sulphates in the ashes, and an excess of barytic chloride. From this solution, properly reduced in volume, potassium may be precipitated by platinic chloride.

Instead of this series of preparatory operations, to be followed by those required by the nature of the double chloride, it occurred to me, at first, to treat a small quantity of the low saccharine product by an excess of sulphate of alumina, and, from the quantity of alum obtained, to calculate that of sulphate of alumina required for the quantity of low products to be treated on a large scale. This idea afterwards led to that of substituting tartaric acid for sulphate of alumina, and, on trying tartaric acid, the results were so uniform and satisfactory that I was induced to apply it to the determination of potassium in compounds of all kinds.

Cream of tartar presents, over every other compound of potassium, the incomparable advantage that, while its solubility is very feeble, the estimation of it, by a titrated alkaline solution, is an operation that only takes a few minutes. To determine the quantity of cream of tartar that we may have to analyse it can be placed in a beaker glass with a sufficiency of water, which it is advantageous to heat, to increase the solubility of the acid tartrate. A few drops of litmus solution will impart a red colour, which will persist as long as any cream of tartar remains in the solution. If now we add a solution of potassa, drop by drop, to the contents of the beaker glass, the acid tartrate will be converted to the basic, and, while the change is going on, the unconverted cream of tartar will continue to colour the litmus red. When the last particle of acid tartrate has been converted to the basic, an addition of the smallest particle of potassa solution will turn the litmus blue. We may now note that the quantity of potassa added to convert the acid tartrate into the basic is exactly the same as the quantity already in combination as acid tartrate. We may note, moreover, that the equivalent of cream of tartar is exactly four times greater than the equivalent of potassa, so that if we have added 1 grm. of potassa to turn the litmus blue, we must have had 4 grms. of acid tartrate, holding in combination 1 grm. of potassa. After every addition of potassa the contents of the beaker should be thoroughly stirred, to dissolve the portions of acid tartrate which are undissolved, but which gradually become soluble as potassa is added. Before the change to the basic condition is complete the crystals of bitartrate disappear, and the red solution becomes perfectly clear. This is an indication that the end is near.

That acid tartrate of potassium is so well adapted to

being tested by a titrated alkaline solution is the quality which, combined with its feeble solubility, recommended it as the compound in which to obtain potassium for analysis. We must, however, increase its insolubility if accurate results are to be obtained, and this can be easily accomplished by means of alcohol.

The insolubility of cream of tartar in a mixture of alcohol and water is greater than in pure water. The following table given by Chancel shows the solubility of cream of tartar in water at several temperatures :—

Degs. C.	100 c.c. of Water dissolve Grms. of Cream of Tartar.
0	0.24
5	0.30
10	0.37
15	0.45
20	0.55
25	0.67
30	0.805
35	0.96
40	1.13

Having had occasion to use this table repeatedly, I have verified these numbers and found them correct.

Chancel has also given us another column, representing the number of grammes of cream of tartar which 100 c.c. of water, containing 10 per cent alcohol, will dissolve at the same temperature. These numbers are nearly 57 per cent of those corresponding to pure water.

To discover the minimum of alcohol which will render a mixture with water incapable of dissolving cream of tartar, a great many experiments were made, and it was found that the mixture containing 60 per cent of alcohol fulfils this condition. By bringing all the liquids containing acid tartrate of potassium to the condition of containing at least 60 per cent of alcohol in volume, I have been able to obtain the whole potassium in the shape of insoluble cream of tartar.

Alcohol of this strength is not, however, to be used from the first, as it may in some cases interfere with the solution of the compounds to be analysed, and sometimes our potassium may be precipitated in other forms than cream of tartar. It should only be used at the last stage, immediately before throwing the precipitate on a filter, so that the acid tartrate in solution may be thrown down. It should also be used to wash the precipitate on the filter, to free it from tartaric and acetic acid, as we shall see hereafter.

To enable me to explain the method of procedure in estimating potassium as acid tartrate, let me take the simplest case which can present itself, which is the analysis of a solution of pure potassa in water. Suppose we have a deci-normal solution of potassa, containing 47 m.grms. of potassa for every c.c. of solution. If we drop 10 c.c. in a beaker glass we may convert the whole of it into acid tartrate if we add a sufficient quantity of tartaric acid. As to what constitutes a sufficiency, we may note that there ought to be enough to precipitate all the potassium to be tested, the minimum being four times as much acid as there is potassium in the compound. We may, however, use a quantity of tartaric acid six times greater than the quantity of potassium to be precipitated. Beyond this, in the presence of alcohol, the precipitate is apt to contain an excess of acid. I am unable to say in what shape this excess of acid exists; but if we use a marked excess of tartaric acid, as much as ten or twelve times more than the potassium to be precipitated, the test by a titrated solution of potassium will give an excess of 2 or 3 per cent. If we have any means of getting approximately at the quantity of potassium in a substance to be tested, we should use six times as much tartaric acid as the supposed quantity of potassium. If, on making the test, we should find that we have gone too wide of the mark, the quantity obtained in a first test will allow us to determine, to a certainty, the quantity to be used in a

subsequent analysis. As every test takes less than an hour, both tests together will take up less time than a single analysis by any other process.

(To be continued.)

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 221.)

Chlorine, Bromine, Iodine, and Fluorine.

By Dr. E. MYLIUS, of Ludwigshafen.

As an interesting fact we may call to mind that at the Paris Exhibition in 1867 large quantities of the silico-fluorides of sodium and barium, of soda-ash, and caustic soda were displayed by Tessié du Motay as products obtained by the application of fluoride of silicon and hydrofluo-silicic acid on the large scale. The hydrofluo-silicic acid was obtained by smelting silicic acid, fluor-spar, and charcoal in a blast-furnace, and receiving in water the fluoride of silicon contained in the flue gases,† a process founded on the observations of Bredberg (1829) and Berthier (1835), and elaborated in its details by F. Bothe.‡

Recently Christy and Bobrownicki|| have taken out a patent in England for obtaining ammonia from ammoniacal waters by means of hydrofluo-silicic acid. They precipitate the ammonia from such water by means of hydrofluo-silicic acid, and decompose the precipitate by means of quicklime without the application of heat. Whether this attempt to employ a siliceous compound in extensive chemical operations will meet with a better fate than its predecessors time alone must decide. It is the first mention of fluorine in chemical technological literature for the last five or six years.

The applications of fluorides seem in fact to be dominated by some hostile influence. Even the use of hydrofluoric acid for etching on glass, which appeared secure from rivalry, will probably experience considerable limitation in consequence of an American invention. B. C. Tilghmann§ uses for etching on glass and other brittle materials a jet of sand violently projected against the surface of the object by means of a current of air or of steam. (The details of this process are, of course, strictly mechanical.)

Against such a rival fluoric acid cannot possibly maintain its ground for etching, especially where large surfaces are concerned. It will be restricted to the production of fine delicate designs, such as the graduation of measuring instruments.

The Sulphur Industry of Sicily. Extracted from the Report of the Mining Engineer, LORENZO PARODI,¶ by Dr. ANGELO BARBAGLIA, Professor of Chemistry at the Istituto Tecnico of Rome.

Sulphur is a widely diffused element which occurs under the most various forms both in the free and the combined state. In a free condition it forms rich deposits, which may be divided into two classes; such as are found on the surface of the earth in the neighbourhood of extinct volcanoes (*solfatare*) forming earthy strata from 6 to 10 metres in thickness saturated with sulphur, and underground beds (*solfare*) in which the sulphur is so intimately

intermingled with the sedimentary rock that it must be obtained by mining. The latter deposits are the more important and furnish nearly the whole of the sulphur of commerce.

Geology.—The most important sulphur deposits are those of Italy.* On the main land are the beds of the Romagna, which yield yearly 120,000 quintals of sulphur those of Latera in the province of Viterbo, and those of Scrofano. Beds of sulphur have also been recently found in the provinces of Volterra, Grosseto, and Avellino.

(To be continued.)

QUANTITATIVE ANALYSIS OF COAL AND PEAT.

By SERGIUS KERN, St. Petersburg.

SEVERAL analytical processes have been used by me for the estimation of carbon, hydrogen, ash, and sulphur in various coals, and most of them were found to be very accurate, but rather troublesome in execution. The following process was used with great success and may be strongly recommended for laboratories of iron works, &c. By this process the work is easily and quickly executed, giving at the same time very accurate results.

1. Estimation of Hygroscopic Water.

3 grms. of the substance in a finely divided state are dried in a porcelain crucible placed in a beaker with a small quantity of sand on the bottom of it. The beaker is covered with a watch-glass, and the whole is placed on a sand-bath and heated for about three hours to a temperature of 110°. The end of the operation is easily known by the dryness of the watch-glass. The substance when dried is weighed, and the percentage of loss is next calculated.

2. Estimation of Carbon and Hydrogen.

The best process was found to be Liebig's:—The ignition of 1 gm. of coal or peat with lead chromate ($PbCrO_4$) in a tube of hard glass, 0.25 metre long. The resulting carbonic acid, water, and sulphuric acid are passed through a potash apparatus containing caustic potash (1 part of KHO dissolved in 2 parts of H_2O), and two U-tubes, the first containing ignited calcium chloride, the second a solution of lead nitrate. The increase in weight of the potash apparatus and of the first U-tube will show the quantity of carbonic acid and water obtained. Knowing that carbonic acid contains 27.2 per cent of carbon, and water 11.1 per cent of hydrogen, the percentage of carbon and hydrogen may be easily calculated.

3. Calculation of the Calorific Power.

As one part of carbon in burning yields 8080 calorific units, and 1 part of hydrogen in burning 34,460 calorific units, the calorific power of the coal may be quickly found.

Example.—Coal from Donetz Mountains, near the village Grouchevka, South of Russia:—

	Per cent.
Carbon	58.0
Hydrogen	11.0
Sulphur	1.0
Ash	23.0
Hygroscopic water	6.0
	99.0

For calculating the amount of calorific units in this coal we proceed as following:—

For carbon we have $0.58 \times 8080 = 4686$
For hydrogen we have $0.11 \times 34460 = 3790$

Total calorific units in the analysed specimen .. 8476

* This statement must be received with grave doubts. It is probable that Iceland contains a very much larger quantity of sulphur than Italy.—*Ed. C.N.*

* "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

† Details concerning attempts at the industrial utilisation of hydrofluo-silicic acid will be found in the article on the compounds of silica.

‡ Bothe, *Wagner Jahresber.*, 1868, 265.

§ *Ber. Chem. Gesell.*, 1873, 1322.

¶ B. C. Tilghmann. The sand-blast for cutting hard bodies.

§ Sull estrazione dello zolfo in Sicilia e sugli usi industriali del medesimo. Relazione dell'ingegnere Lorenzo Parodi al Ministro d'agricoltura, industria e commercio. Firenze, 1873.

4. Estimation of Ash.

1 grm. of powdered coal is heated in a muffle in an open platinum dish till all the carbon is burnt off. The remainder is the ash which is weighed.

5. Estimation of Sulphur.

0.5 grm. of powdered coal is heated with a mixture of 15 c.c. of HCl and 5 c.c. of HNO_3 for about one hour, and next left for 12 to 15 hours on a sand-bath. The liquor is filtered on a strong double filter to prevent the coal-dust passing into the filtrate. The sulphur is precipitated from the filtrate by barium chloride. The solution is left quiet for half an hour and is next filtered; the precipitate of BaSO_4 is washed, dried, and then weighed. Supposing 0.5 grm. of coal to be used for the analysis, every 0.001 grm. of barium sulphate obtained is equal to 0.02 per cent of sulphur.

Obouchoff Steel Works,
St. Petersburg.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 3rd, 1876.

"On the Action of Water and Saline Solutions upon Lead," Part II., by M. M. PATTISON MUIR, F.R.S.E., Assistant Lecturer on Chemistry, Owens College.

(Concluded from page 225).

5. Does free admission of air to the surface, or passage of air through the body of the liquid influence the quantity of lead dissolved? The bearing of the experiments

upon this question will be best seen by tabulating the results so as to bring together the quantities of lead dissolved by the same liquid acting on a fixed surface, but under varying conditions of exposure to air.

This is done in Table II.

I have not tabulated the whole of the results here, but only those which are directly comparable with one another.

6. It is scarcely admissible from these experiments to conclude that exposure to air invariably causes an increase in the quantity of lead dissolved. As in the consideration of the influence of surface exposed, it was found to be difficult, if not impossible, to eliminate other circumstances which modified the action, so here we appear to have many conditions tending to overshadow the effects of that one which it was especially desired to study. If we compare the quantities of lead dissolved in corked flasks and in open beakers, the action appears to be greater in the former than in the latter cases, until we come to deal with actions allowed to proceed during considerable periods of time, and upon somewhat extended surfaces of lead. When the surface exposed extended to 50 sq. cm. (to 500 cbc. of liquid) and the time of action amounted to 300 to 500 hours, the exposure of the surface of liquid to a considerable surface of air invariably increased the quantity of lead dissolved in a given time.

In these experiments the surface of liquid exposed to the air was increased from about 2 to about 100 sq. cm.

By comparing the quantities of lead dissolved in flasks or beakers and in open basins we find that there is invariably a very marked increase in the latter cases. The increase here also becomes more marked when the action has been allowed to proceed for tolerably extended periods of time.

In these experiments the surface of liquid exposed to the action of air increased from about 2 to about 170 sq. cm.

A.—Liquid employed, Distilled Water.

Description of Vessel.	Surface of Lead.	Total Lead (in Mgrs.) Dissolved after—				
		42	168	336	340	505
Corked flask	25	0.7	—	—	1.2	1.5
Beaker half filled with water 11.5 cm. diam. at mouth	"	0.4	—	—	0.5	0.8
Basin, 14.5 cm. diam. ..	"	0.6	—	—	2.0	4.2
Flask with air passed through	"	—	—	—	1.5	2.0

C.—Liquid employed, Potassium Nitrate, 0.20 grm. per Litre.

Flask	25	0.7	—	—	1.2	1.6
Beaker	"	0.4	—	—	0.4	0.5
Basin	"	0.8	—	—	2.8	6.0

E.—Calcium Chloride, 0.20 grm. per Litre.

Flask	25	—	1.3	1.8	—	3.0
Beaker	"	—	1.3	1.5	—	2.8
Basin	"	—	2.0	3.0	—	5.5
Flask with air	"	—	3.5	3.5	—	3.5
Beaker—lead partly suspended in liquid, partly in air	"	—	1.4	2.5	—	3.5

G.—Potassium Carbonate, 0.20 grm. per Litre.

Flask	25	—	traces	0.3	—	0.3
Beaker	"	—	0.2	0.3	—	0.3
Basin	"	—	0.5	0.7	—	0.7
Flask with air	"	—	0.4	0.6	—	0.6
Beaker—lead partly suspended in air	"	—	traces	0.2	—	0.3

I.—Ammonium Sulphate, 0.20 grm. per Litre.

Flask	25	—	0.5	0.7	—	0.7
Beaker	"	—	0.7	1.0	—	1.3
Basin	"	—	2.5	9.0	—	16.0?
Flask with air	"	—	1.3	3.0	—	5.0
Beaker—lead partly in air ..	"	—	0.8	1.5	—	2.5

B.—Liquid employed, Distilled Water.

Vessel.	Surface.	Lead Dissolved.				
		42	168	336	340	505
Flask	50	0.7	—	—	0.9	1.0
Beaker	"	0.4	—	—	1.2	1.8
Basin	"	0.8	—	—	1.5	3.5

D.—Potassium Nitrate, 0.20 grm. per Litre.

Flask	50	1.0	—	—	1.2	1.5
Beaker	"	0.6	—	—	2.2	2.5
Basin	"	1.1	—	—	2.8	3.5

F.—Calcium Chloride, 0.20 grm. per Litre.

Flask	50	—	2.0	2.5	—	2.5
Beaker	"	—	2.0	3.0	—	3.5
Basin	"	—	2.5	3.5	—	4.5
Flask with air	"	—	0.5	0.5	—	0.5

Beaker—lead partly suspended in air	"	—	2.1	3.5	—	4.0
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H.—Potassium Carbonate, 0.20 grm. per Litre.

Flask	50	—	traces	0.3	—	0.3
Beaker	"	—	0.2	0.3	—	0.3
Basin	"	—	0.7	0.9	—	0.9
Flask with air	"	—	0.5	0.5	—	0.5

Beaker—lead partly in air ..	"	—	0.5	0.7	—	0.7
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J.—Ammonium Sulphate, 0.20 grm. per Litre.

Flask	50	—	0.7	0.7	—	0.7
Beaker	"	—	0.7	1.0	—	1.5
Basin	"	—	2.5	7.5	—	12.0
Flask with air	"	—	0.7	1.3	—	2.5
Beaker—lead partly in air ..	"	—	1.0	2.0	—	3.5

It may be that the relation between lead exposed and total quantity of liquid influences the action of the air upon the metal; this point I propose to examine in a further communication. The passage of air through the various liquids certainly caused an increase in the quantity of lead dissolved as compared with those quantities found when the action was allowed to proceed in closed flasks; nevertheless, in every case—with one exception—considerably smaller quantities were dissolved when air was passed through the liquids, than when large surfaces of liquid were merely exposed to the action of the superincumbent air.

I have already pointed out, when considering the influence of the extent of surface of lead exposed, that the only experiments in which a constant increase in lead dissolved (independent of the salt in solution, the time, &c.) was noticed, were those in which the lead was partially suspended in the liquids and partially surrounded by air, the liquids being contained in beakers and exposing a surface of about 100 sq. cm. to the surrounding air. If we compare the quantities of lead dissolved under these conditions with the quantities dissolved in experiments carried out in a precisely similar manner, except that the lead was wholly surrounded by liquid, we find that there was a small but constant increase in the former cases; the quantities dissolved in these cases were not so large as those which passed into solution when the experiments were carried out in basins and the lead was wholly immersed in the liquid. On the whole, then, the exposure of the various liquids to a large surface of air appears to cause an increase in the quantity of lead dissolved; this increase becomes specially marked after the lapse of considerable periods of time.

7. Do the solvent actions of dilute saline solutions upon lead continue during lengthened periods of time, or is there a limit reached after which little or no further action is exercised upon the lead?

By consulting the two tables it becomes very evident that so far as these experiments allow one to judge there is a constant increase of lead dissolved with increase of time of action, except in the case of those solutions which contain carbonate of potassium. This increase appears to be proportionately greater in the case of those salts (nitrates, &c.) which aid the solvent action, than of those which tend to stop the solvent action of water upon lead. This increase is also greater for equal time-intervals, when a large surface of liquid is exposed to the surrounding air than when a small surface is so exposed. The increase was not very marked when the experiments were conducted in flasks, through which a stream of air was constantly passed.

The exception which I have made in favour of potassium carbonate, when laying down the general rule, that increase of duration of action increases the quantity of lead dissolved, requires explanation. On examining the actual numbers obtained it is evident that the amount of lead dissolved by liquids which contained potassium carbonate did increase as the action proceeded, up to a certain point; this increase was, however, very slight, and after the expiry of 340 hours it ceased. Hence, I conclude provisionally that in the presence of this salt the solvent action of water upon lead soon—comparatively speaking—reaches a maximum. I intend to investigate this subject more fully in a future communication.

8. In conclusion, it appears to be shown by these experiments that the solvent action of dilute saline solution upon lead tends to attain a maximum when large surfaces of liquid are exposed to the surrounding air, and when the volume of liquid is large in proportion to the surface of lead exposed. Further, that under these conditions, and in the presence of those salts which aid the action—especially nitrates, and more especially ammonium nitrate—the quantity of lead dissolved increases in an increasing ratio with the time during which the action is allowed to proceed.

Many experiments must, however, be yet carried out

before I can permit myself to generalise with safety, and these experiments must be conducted on a larger scale before the results obtained can be applied to the actual conditions which influence the mutual action of water and lead in our domestic water supply.

9. By comparing the absolute quantities of lead dissolved as stated in the foregoing tables with those tabulated in the former papers and obtained under somewhat comparable circumstances, it is apparent that the present numbers are much smaller than the former. This I believe to be due to the chemical purity of the lead itself. In former experiments I made use of ordinary sheet lead; in the present experiments what is sold by the chemical dealer as "pure lead" was employed. I believe that many contradictory results noticed in the numbers obtained by different experimenters on the subject of the action of water on lead can be traced to slight differences in the purity of the lead employed by them. I purpose to examine this subject quantitatively, and hope, on a future occasion, to lay the results before the Society.

NOTICES OF BOOKS.

Report on the Ventilation of the Hall of Representatives and of the South Wing of the Capitol of the United States. By R. BRIGGS, C.E. Philadelphia: H. B. Ashmead.

WHAT can be simpler, theoretically speaking, than ventilation? Air as it is contaminated by the products of combustion and of respiration, and by the effluvia from the bodies of animals, is heated *pari passu*. Now, as gaseous matter under such circumstances expands and becomes specifically lighter, the foul air has a tendency to ascend, and all we have to do is to make two apertures, one at the top and the other at the bottom of the building, when, heigh! presto! the foul air will escape from the former, whilst fresh pure air will rush in from below and take its place. Yet this system, so admirable in its broad theoretical outline, in practice will not work at all. The aperture in the roof of the building made for the ascent of the impure air becomes the battle ground of contending currents. Sometimes the rising stream flows out unchecked and then again the cold external air forces its way down upon the heads of the inmates. Nor is it actually true that foul air is always and necessarily heated. The "ground gases," which Prof. v. Pettenkofer has brought to our knowledge, are no less dangerous than the effluvia from living animals, but their temperature is low and they ooze into houses and public buildings from beneath. Hence, wherever a large number of persons are likely to be collected together, as in churches, theatres, courts of justice, legislative halls, &c., special arrangements are required for the construction and adaptation of which sound physical knowledge is required. Even when eminent authorities have been consulted and expense has been incurred without limit the result is frequently far from satisfactory. Some of us may yet remember the verses in *Punch* beginning:—"This is the house that Barry built."

According to the view taken in the pamphlet before us the allowance of air per minute for each individual in a public building may range from 30 cubic feet in winter to 100 cubic feet in summer. This supply in a hall like that of the American House of Representatives, which may at times contain 1600 persons, will therefore range from 50,000 to 100,000 cubic feet per minute. In many instances there is some difficulty in selecting a suitable place whence so large a volume of air may be safely drawn. If the opening be near the surface of the soil "ground air," sewer gases, emanations from "made ground," and from putrescent matter of all sorts and dust may be sucked in. Nor is the summit of a tower any

great improvement. The authors of the report before us remark:—"The elevated air is more impure when the stratum of diffused chimney exhalations is reached, than it is below. The Londoner *does not* experience any great sense of purity of air from the top of St. Paul's as a general rule; and the haze of any large city is perceptible for miles on a still day—the entire city is covered as with a blanket by an *ascending and dispersing* cloud, and receiving its fresh air from beneath from all sides." In the American Capitol the air is drawn from the level of an elevated terrace, some 30 feet wide and 35 feet in height, beyond which lies a park, 800 to 1000 feet in width, carefully drained, and, as a matter of course, free from nuisances. A more favourable locality for drawing a supply of pure air could not well be selected. But when a proper source of fresh air has been found its introduction into the room involves two questions which may lead to four different systems. Are we to adopt the "*vacuum*" or the "*plenum*" method? In other words, are we to draw the foul air out or to force the fresh air in? A little consideration will show that the latter or *plenum* method is decidedly preferable. If we suck out the foul air, other air will stream in to supply its place, not merely from our carefully selected source of a supply, but from every conceivable quarter. We shall suck in "ground gases" from the soil beneath and through the foundations. The next question is whether we are to introduce pure air from above or from below? If we select the former method our descending stream of pure air meets the stream of contaminated air arising from the persons of the occupants, and the latter current, instead of being withdrawn as quickly and quietly as possible, is beaten back upon the inmates, and runs a great risk of being inhaled over again. The method actually adopted in the Hall of Representatives is the *plenum* from below. As a matter of course the temperature of the in-flowing current requires to be regulated. By means of a system of steam-pipes it is kept at the uniform heat of 70° F., which is found most conducive to the comfort of those present in the building. The fresh air enters through vertical gratings in the steps of the platforms, upon which the seats of the members are placed. The reason why horizontal gratings in the floor were not adopted is somewhat singular.

"The nearest approach to a uniform distribution would of course have been attained by the perforated floor and porous carpet of the House of Lords, England, but the habits of our people in use of tobacco put this method out of the question."

We learn from the Appendices that the arrangements or the ventilation of the Hall of Representatives, though originally well designed and efficient, have not been in all points maintained in thorough working order. The best systems in ventilation, as in everything else, are of little avail unless they are carefully attended to. The authors conclude with a significant reflection:—"The truth is, all our heating and ventilating appliances are a compromise of conditions—a truth extending beyond all mechanical operations to the phenomena of nature herself." On this we may all meditate with advantage.

Programme of the Royal Rhenish-Westphalian Polytechnic School of Aachen, for the Course 1876-77. Aachen: J. J. Beaufort.

On a former occasion we have called attention to the admirable arrangements of this college for the study of applied science, and we find that they are still maintained in full efficiency. As an instance of the combined thoroughness and many-sidedness evinced in the culture of science, we may briefly describe the chemical course:—Dr. Landolt gives six lectures weekly on experimental chemistry, the winter term being devoted to the inorganic

and the summer term to the organic department. There is a "chemical colloquium" of one hour weekly, for the purpose of impressing the more important points of pure chemistry upon the students. Dr. Classen gives instructions in analytical chemistry two hours weekly, and the analytical department of the laboratory is open daily, except Saturday, for seven hours, under the superintendence of Prof. Landolt, and Drs. Classen, Brühl, and Clören. Prof. Stahlschmidt gives weekly four hours' instruction in technological chemistry, and four hours in the construction and arrangement of chemical manufactories, and, with his assistants Drs. Böckmann and Scheele, superintends practical work in the technological laboratory daily, except Saturday. Dr. Brühl lectures twice weekly in the summer term on theoretical chemistry. Dr. Landolt gives practical instructions in saccharimetry. Dr. Classen gives, in the summer time, one lecture weekly, on chemical jurisprudence and toxicology, and in the winter term on the determination of the illuminating power of gas and its technological analysis. Prof. Stahlschmidt lectures weekly on brewing and on the manufacture of beet-root sugar. Dr. Böckmann delivers two lectures weekly on dyeing and calico-printing, and two on stoichiometry. In addition to all these facilities the students have the opportunity of visiting different chemical works in the surrounding country. We commend these complete and thorough-going arrangements to the careful consideration of the authorities of our new colleges in Leeds, Newcastle, Birmingham, and Bristol.

CORRESPONDENCE.

ANTHRACENE PRODUCTION.

To the Editor of the Chemical News.

SIR,—In your journal of the 17th inst. is published an article on "Anthracene Production," by Dr. Frederick Versmann, in which the balance-sheet of the *Chemische Industrie Aktien Gesellschaft* of Elberfeld, as recently published, is referred to in the following manner:—

"In Germany all public companies are very properly compelled by law to publish their annual balance-sheet in at least three newspapers, and such document—published only on the 10th inst., in the *Cologne Gazette*—by the '*Chemische Industrie Aktien Gesellschaft zu Elberfeld*,' formerly Gessert Brothers, tells its own tale in a few figures. This official document informs the shareholders that the loss of the twelve months' working, ending at Midsummer last, amounts to £40,000; and as this dismal statement is merely a repetition of previous equally unsatisfactory balance-sheets, there seems to be little doubt that at next month's general meeting the Company will be wound up, and that very likely the whole capital—amounting to some £180,000—will be lost."

By request of the *Chemische Industrie Aktien Gesellschaft* of Elberfeld we now beg to hand you a true copy of the said balance-sheet, from which you will see that the figures given by Dr. Versmann are inaccurate and his observations most unjustifiable.

The profit and loss account is debtor about £40,000, but this amount is the actual loss during the past three years, and not during one year. The capital of the company is £150,000, not £180,000.

Dr. Versmann takes upon himself to say that at the next general meeting of the company "very likely the whole of the capital will be lost."

As Dr. Versmann bases his remarks upon the figures given in the balance-sheet, we refer you to that document, which describes the position of the company on June 30, 1876, as under:—

* "Programm der Königlichen rheinisch-westfälischen Polytechnischen Schule."

Works, Plant, and other assets ..	2,890,680	44 marks.
Liabilities	689,989	28 "
Balance	2,200,691	16 "

or about £110,000.—We are, &c.,

POKORNY, FIELDER, and Co.

15, Fish Street Hill, London,
November 29, 1876.

[The name and address of Dr. Versmann was affixed to the article in question, and bearing in mind that he is an authority on the subject of anthracene, and indeed on any branch of the art and science of dyeing; that he is, moreover, a German, and was therefore in a position to satisfy himself that the sources from which he obtained his information were trustworthy, we did not hesitate to publish his paper. On receiving the above letter we communicated with Dr. Versmann, and we insert his reply. We have examined the copy of the balance-sheet, but we do not find it stated that the £40,000 is the loss during the past three years. We gladly, however, give publicity to the fact as stated by Messrs. Pokorny, Fielder, and Co.—Ed. C. N.]

To the Editor of the Chemical News.

SIR,—I am obliged to you for communicating to me Messrs. Pokorny, Fielder, and Co.'s letter to you before its publication, and thereby affording me the opportunity of at once replying to it.

These gentlemen, on behalf of the "Chemische Industrie Aktien Gesellschaft," at Elberfeld, call my figures in reference to this Company inaccurate, and my observations unjustifiable. They point out two errors in the figures in my article, and to these I will confine myself.

I stated the loss of the last twelve months' working at £40,000. This information I took from the balance-sheet published by the Company in the *Cologne Gazette* of the 10th inst., which document is identical with the true copy sent to you by Messrs. Pokorny, Fielder, and Co. We are now told that £40,000 loss has been incurred during three years; but I submit the balance-sheet itself allows of but one reading. It is headed, translated, "Balance-sheet, June 30th, 1876, for the period from July 1st, 1875, to June 30th, 1876," and one of the items of this twelve months' working is put down as £40,000 loss. I really cannot be held responsible for any inaccuracy in the official published balance-sheet.

The second point refers to the amount of capital, which I stated at some £180,000, taking the share capital of £150,000 and debts of £30,000 together in one sum; and if the adding up of these two items, instead of specifying them, should have given any cause for complaint, I truly regret my short way of expression.

As to my observations generally, I need scarcely assure you that I have not been influenced by any unfriendly or personal feeling, as I am ignorant of the very names of any proprietors. But I shall be delighted to learn that I have drawn too gloomy a picture of the prospects of the company under the impression that the £40,000 had been lost during one year. However, as I am now informed that this adverse result has to be spread over three years, I most sincerely trust that this company will not only soon recover the heavy losses hitherto made, but will in no distant time become a concern very profitable to the shareholders.—I am, &c.,

FREDERICK VERSMANN.

35, Whitecross Place, Wilson Street, Finsbury, E.C.

ON ANTHRACENE PRODUCTION.

To the Editor of the Chemical News.

SIR—Our attention has been drawn to the remarks of Dr. Frederick Versmann (*CHEMICAL NEWS*, vol. xxxiv. p. 211),

who says "that most of the anthracene at present in the market is of a very doubtful character." From the complaints of our alizarine friends (as brokers in this article) we think the Doctor is quite justified in his scientific conclusions; we, of course, can only speak from a business point of view. We find that the best way to get over the difficulty is for the consumers to try a ton or so of each producer's make, by which means they become acquainted with the kind of anthracene that suits their working into alizarine. Both parties obtain mutual benefit. The alizarine manufacturer can calculate with certainty, and so avoid heavy losses; the producers, also, can obtain better prices by giving satisfaction. Apologising for troubling you,—We are, &c.,

JOSEPH BENNETT BROS.

22 and 23, Great Tower Street, London, E.C.,
November 27, 1876.

DISTILLATION OF SEAWEED.

To the Editor of the Chemical News.

SIR,—In Dr. Hofmann's report on iodine (see *CHEMICAL NEWS*, vol. xxxiv., p. 215) he speaks of my process having "evidently failed in practice," and that "nothing further has been heard of the distillation of seaweed, and the production of iodine from the residual charcoal." I beg to state that ever since 1863 the process has been worked with great success in the Island of Tyree and other parts of the West Highlands. The produce of iodine in that island has been increased nearly ten-fold, and I need only refer to the evidence of His Grace the Duke of Argyll before the Privy Council last year to show the remarkable benefit to the people of that island. It has not been largely extended, because all proprietors of shores are not so enlightened as His Grace.

Dr. Hofmann quotes a letter from me, written some time ago (p. 197), in which the price of iodine is quoted at 1s. 3d. per ounce; it is now only 5½d. per ounce. In a short paper read before the British Association at their meeting here there are some interesting statistics about iodine, which I shall shortly send you for publication. Meantime, if Dr. Hofmann disbelieves in the existence of seaweed charcoal, I shall be glad to supply him with a thousand tons at a very low rate, and if he can make the order ten times as large it will afford me a proportional pleasure to execute it.—I am, &c.,

E. C. C. STANFORD.

The North British Chemical Company (Limited),
149, Hope Street, Glasgow, Nov. 26, 1876.

THE D-LINES SPECTRA FLAME EXAMINED
BY THE BLOWPIPE.

To the Editor of the Chemical News.

SIR,—I feel so much indebted to your correspondent "NaHO" for calling attention to this important subject in the *CHEMICAL NEWS*, vol. xxxiv., p. 226, that I will waive the obvious advantage he takes by entering upon such a controversy under the shelter of an anonymous signature, and shall only remark, with reference to the personalities in his letter, that his opinion regarding my writings generally can only be of value in the eyes of the public when his real name, honestly and courageously appended to them, shows how much we may attach to it. If we are to judge of this value from the contents of the anonymous letter, our estimate will not be oppressively great.

Let us now weigh the facts adduced by your correspondent, and see if they can stand against my tentative "series, which," he rather ungrammatically observes, "are a fair specimen of the experimental method as followed by chemists."

(1.) He tells us that "at a white heat the sodium sal adherent to platinum wire is volatilised, while at a low

temperature the spectrum is more permanent." Now, considering that, in the experiment to which this remark refers, *the same platinum wire was used*, though inserted in different parts of the blowpipe "flame," the assertion here made by your correspondent is that the trace of sodium, having been first volatilised, is *reproduced* permanently by the use of a lower temperature!

(2.) The argument as to the production of the "D-lines" by the combustion of sodium in a vacuum tube, has been previously well considered by me. No one knows better than the distinguished editor of the *CHEMICAL NEWS*, who has succeeded more nearly than, perhaps, any man in Europe in the attempt to obtain it, that the artificial production of a *perfect* vacuum is almost, if not quite, an impossibility, and, where there is a particle of air, sodium will, in combustion, derive water. Has your correspondent tried the experiment himself? If not, let him do so, and he will find that soda is produced by the combustion, in spite of his "vacuum."

(3.) The opalescence caused in pure boric acid by the impingement upon it of the orange flame emitted from platinum is "positive evidence of the absence of sodium (in from ?) that flame" when taken in conjunction with the other fact mentioned by me, that the orange flame from a sodium salt *removes that opalescence*.

(4.) The *onus probandi* of showing that the "D-lines" are produced by sodium only evidently rests with the sodiumite. The supporter of the water hypothesis has only to show (as I consider I have fairly shown) that they are not.—I am, &c.,

W. A. Ross.

London, November 27, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

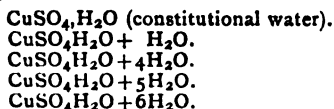
NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 20, November 13, 1876.

Mineralogical and Geological Researches on the Lavas of the Dykes of Thera.—M. Foqué.—The present paper is a report by MM. Charles, Sainte-Claire Deville, Des Cloiseaux, and Daubrée. It appears that in all the lavas of Thera there are at least two, and often three, triclinal felspars. The predominant felspar (among the microlithes) is albite, but among the larger crystals it is sometimes labradorite, and sometimes anorthite. The labradoric lavas free from olivine and rich in tridymite contain a ferruginous pyroxene, and have a proportion of silica intermediate between those of the acid and the basic lavas. The anorthitic lavas in which olivine is abundant and tridymite rare contain very little silica, and may be regarded as basic rocks.

Influence of Temperature upon Magnetisation.—M. J. M. Gauguain.—In operating upon a bar of steel capable of undergoing a considerable transient variation the magnetism is much weaker at 300° than at the ordinary temperature. When, on the contrary, the transient variation of the bar is very small, the magnetisation is more powerful at 300° than at a lower temperature.

Hydrates of Copper Sulphate.—M. L. Magnier de la Source.—Copper sulphate presents several distinct degrees of affinity for water corresponding to the hydrates—



o complete this series must be added the hydrate,

$\text{CuSO}_4 \cdot \text{H}_2\text{O} + 2\text{H}_2\text{O}$, which is formed when crystals of blue vitriol are exposed to dry air at 25° to 30°. This new hydrate is stable enough to resist a dry vacuum, whilst under the same circumstances the original hydrate loses its 4 molecules of crystalline water.

Margaric Chloride and its Derivatives.—A. Villiers.—This compound, $\text{C}_{32}\text{H}_{34}\text{ClO}_2$, was obtained by the action of phosphoric perchloride upon the margarate of soda.

Researches on Quercite.—L. Prunier.—The author considers that quercite is a compound forming the transition between the fatty and the aromatic series.

On Angelic Acid.—E. Demarcay.—Not suitable for abstraction.

Existence of Asparagin in Sweet Almonds.—L. Portes.—Having established the presence of asparagin, the author thinks it evident that in almonds—on account of their oily nature—the products of transformation due to the germinative process appear at an earlier period than in other seeds.

A Meteoric Iron, very rich in Nickel, found in the Province of Santa Catarina (Brazil).—E. Guignet and G. Ozorio de Almeida.—The specimen contains 36 per cent of nickel, and is free from chrome, cobalt, manganese, and copper; neither is it mixed with any earthy gangue.

Chemical Composition of the Water of the Bay of Rio de Janeiro.—E. Guignet and A. Teller.—Silica and alumina are constantly found in considerable amount, even in samples carefully filtered. The water has a decided alkaline reaction, due neither to ammonia nor to carbonate of ammonia, but to soda and potassa, present as silicates and aluminates.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. No. 34, October, 1876.

Methods employed to Determine the Nature of the Colouring Matters Introduced into Wines.—A report by MM. Balard, Pasteur, and Wurtz.—To detect indigo, which is often used in the shape of sulphate, the authors add a little sulphate of potassa, and precipitate with chloride of barium. The sulphate of baryta, after filtration and washing, appears white if the wine is free from indigo, but if that dye is present it has a decided blue tint. Magenta is probably never employed alone in the fraudulent coloration of wines, but along with indigo it can be made to produce vinous reds. To detect this dangerous impurity the authors agitate the suspected wine with a small quantity of amylic alcohol. This withdraws the dye, and collects upon the surface of the wine, where it forms a bright red stratum. If this rose-coloured liquor is treated with a small piece of clean white silk, not mordanted, the latter takes the well known shade of magenta, which turns yellow if the silk is touched with a drop of hydrochloric acid. An appendix by Dr. Stierlin gives a tabular view of the behaviour of different reagents with wines coloured with dyes as compared with pure red wine.

MISCELLANEOUS.

Organisation among Chemists.—The committee appointed to take this matter in hand met for the first time on Saturday, November 25, at Burlington House. There were twenty-eight members present. The following gentlemen were elected Officers of the Committee:—Dr. Frankland, Chairman; Dr. Williamson, Prof. Abel, and Dr. Voelcker, Vice-Chairmen; Dr. C. R. A. Wright, Treasurer; Mr. W. N. Hartley, Secretary. The names of Prof. Dittmar, of Glasgow, and of Dr. Graham, of University College, London, were added to the Committee, but it was decided that for the present no further additions should be made. A sub-committee of seven Members was appointed to prepare a draft scheme for the consideration of the General Committee upon which the constitution and

rules of the new association may be founded. The following were nominated by ballot to serve on this committee:—Prof. Abel, Mr. Carteighe, Prof. Frankland, Mr. W. N. Hartley, Mr. Neison, Dr. Voelcker, Dr. C. R. A. Wright.

The Royal Society.—Yesterday being St. Andrew's Day, the Anniversary Meeting of the Royal Society was held. The following Officers were elected for the ensuing year:—

President—Joseph Dalton Hooker, C.B., M.D., D.C.L., LL.D.

Treasurer—William Spottiswoode, M.A., LL.D.

Secretaries—Prof. George Gabriel Stokes, M.A., D.C.L., LL.D.; Prof. Thomas Henry Huxley, LL.D.

Foreign Secretary—Prof. Alexander William Williamson, Ph.D.

Other Members of the Council—Major-General John T. Boyleau; Warren De la Rue, D.C.L.; Prof. P. Martin Duncan, M.B., P.G.S.; Prof. William H. Flower, F.R.C.S.; Prof. Michael Foster, M.D.; Edward Frankland, D.C.L.; Francis Galton, M.A.; William Augustus Guy, M.B.; John Russel Hind, F.R.A.S.; The Rev. Robert Main, M.A.; William Pole, C.E., Mus. Doc.; The Rev. Bartholomew Price, M.A.; Rear-Admiral G. H. Richards, C.B.; Henry Clifton Sorby, Pres. Soc.; Prof. Henry J. Stephen Smith, M.A.; Prof. Balfour Stewart, M.A.

MEETINGS FOR THE WEEK.

MONDAY, 4th.—Society of Arts, 8. (Cantor Lectures.) "The History of the Art of Coach Building," by Mr. G. A. Thrupp. Lecture III.—Carriages from 1770 to the present time.

— Medical, 8.
— Royal Institution, 2 (General Monthly Meeting).
— London Institution, 5.

TUESDAY, 5th.—Civil Engineers, 8.
— Zoological, 8.30.

WEDNESDAY, 6th.—Society of Arts, 8. "Street Tramways," by Captain Douglas Galton, R.E., C.B., F.R.S.

— Geological, 8.
— Microscopical, 8.
— Pharmaceutical, 8.

THURSDAY, 7th.—Royal, 8.30.
— Chemical, 8. "Analysis of a Species of Erythrophyl," by Prof. Church. "On Phenylindiamine," by Dr. Witt. "On Calcium Sulphate," by Mr. Hannay.

Royal Society Club, 6.30.

FRIDAY, 8th.—Astronomical, 8.
— Quekett Club, 8.

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ACETONE,

CHLOROFORM,

ALDEHYDE,

CHLORATE BARYTA,

ARSENIC ACIDS,

FRUIT ESSENCES FOR CON-
FECTIONERY & LIQUEURS,

PERCHLORIDE OF IRON,

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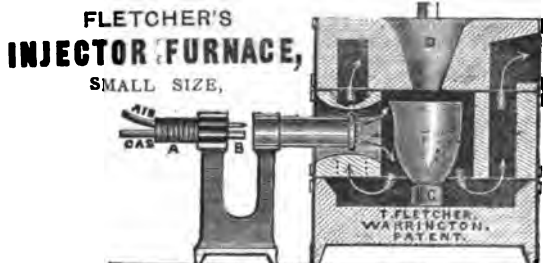
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THE CHEMICAL NEWS.

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ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 230).

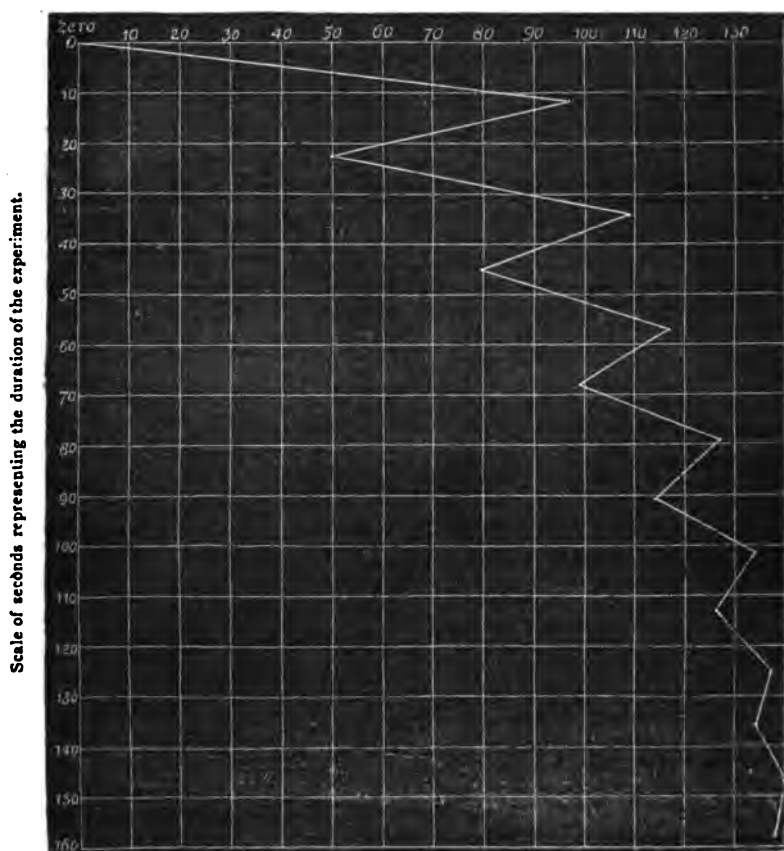
106. It was found that when a source of light and heat is suddenly allowed to shine on the pith surface and not removed, a deflection rapidly takes place, attaining its maximum in about 11 seconds; the spot of light now returns a few degrees, and then proceeds in the first direction to a greater extent than at first. So it goes on, by alternate steps, advancing a little each oscillation,

zero, where the spot of light normally rests. The vertical figures represent the seconds during which the experiment lasted. The zigzag line represents the oscillations of the spot of light, and shows the movement of the pith surface under the influence of a uniform source of radiation. The time was recorded by a chronograph. Starting from zero the spot of light is seen to have travelled to 97° in 11.5 seconds; at the end of 11 more seconds, or 22.5 seconds altogether, it had come back to 50° ; at the end of 34 seconds the light had advanced again to 109° , and so on. The movements are tolerably uniform as to time, taking about 11.5 seconds for the half oscillation, but the amplitude of vibration is continually diminishing

107. If, however, the light is only allowed to shine on the pith surface for 11.5 seconds (or for as long as the spot of light takes to perform its first half oscillation), and if it is then instantly cut off, the spot of light almost invariably returns to zero and stops there, instead of swinging to the opposite side and only returning to rest after ten or a dozen oscillations, as is the case when the beam is set vibrating by mechanical means. This behaviour

FIG. 9.

Degrees on scale, representing repulsion.



until, if the light be feeble, the index takes up a nearly fixed position; if, however, the light be strong, the beam is driven against the side of the tube. In illustration of this I select the following series of observations from a large number recorded in my note-book. The horizontal figures represent the degrees on the scale, starting from

points to the return movement taking place under the influence of a force which remains active after the original radiation is cut off, and which is only gradually dissipated. This force is most probably from the heat which the pith has absorbed raising its temperature; and the steady return to zero seems to be due to the movement being controlled by the radiation of heat by the pith.

108. A series of observations taken with another apparatus, with the object of ascertaining the times o

* A Paper communicated to the Royal Society, March 20, 1875. From the *Philosophical Transactions of the Royal Society of London*, v l clxv., pt. 2.

Interposed Screen.	Magnesium wire burnt for 7.5 secs. distant 140 millims.	Standard candle, distant 140 millims.	Standard candle, distant 280 millims.	Copper ball 400° C., distant 140 millims.	Copper ball 400° C., distant 280 millims.	Copper ball 100° C., distant 140 millims.
None	—	—	54	—	180	9
Rock-salt, 20 millims. thick, not very clear ..	—	148	52	220	—	6
Rock-crystal, in two pieces, 42 millims. thick } altogether	—	88	32	115	—	1.5
Talc, clear but very dark, 1.25 millims. thick..	—	100	28	90	—	2
Plate glass, white, 2 millims. thick, one piece	—	—	—	—	—	3.25
Ditto, two pieces	—	—	—	110	—	1.75
Ditto, three pieces	—	72	24	76	23	0.62
Ditto, two pieces, enclosing 8 millims. water..	—	—	—	0	0	0
Plate glass, of a greenish colour, 10.5 millims. } thick	—	55	17	—	20	0
Ditto, 20 millims. thick	—	—	8	—	—	0
Alum, a clear plate, 5 millims. thick	—	18.5	3	—	0	0
Plate glass, slightly greenish, 40½ millims., and } clear alum plate, 8½ millims. thick	30	0	0	0	0	0
Calc spar, 27 millims. thick	—	—	—	78	—	—
Very thin film of mica	—	—	off the scale	—	—	8
Ammonio-sulphate of copper, 8 millims. thick- ness of solution, opaque to rays less re- frangible than line F.	72	7	—	0	0	0
Ditto, stronger solution, opaque below G. ..	29	3	—	0	0	0

oscillation to and fro, showed that the first half, or the maximum deviation produced, whilst under the influence of radiation, occupied about the same time as the second half, or the return swing, when the source of radiation was cut off. The following are the observations. The source of radiation was a candle, the intensity of action being moderated by filtering the rays through glass screens.

Half Oscillation, under Influence of Radiation.	Whole Oscillation, Radiation being cut off during the return swing.
8.00 seconds.	15.00 seconds.
7.50 "	15.00 "
7.50 "	14.50 "
7.50 "	15.50 "
7.50 "	14.50 "
7.25 "	15.00 "
7.50 "	15.00 "
7.50 "	15.00 "
7.00 "	14.00 "
7.00 "	14.00 "
6.75 "	14.00 "
7.00 "	14.00 "
7.25 "	15.00 "
7.00 "	14.00 "
7.00 "	13.25 "
8.00 "	16.00 "
8.00 "	16.00 "
7.50 "	15.00 "
7.00 "	15.00 "
8.00 "	15.00 "
8.50 "	15.50 "
7.50 "	15.00 "
8.00 "	15.00 "
8.00 "	15.00 "
7.00 "	14.00 "

Mean..7.47 " Mean..14.77 "

The average time of the first half oscillation is therefore 7.47 seconds,* and of the second half 7.3 seconds. This small difference is not unlikely to be due to errors of observation.

After a long series of experiments the zero gradually creeps up, showing that one side of the apparatus is becoming warmed. The conducting power for heat and condition of the surface (whether coated with lampblack

* By referring to paragraphs 106 and 107 it will be seen that I have put the time of the first half oscillation as 11.5 seconds. This was with another apparatus, having a glass thread of different torsion.

or consisting of polished metal) of the body on which radiation falls materially influence the movements.

109. The accompanying table gives the results of numerous experiments as to the effect of screens, tried with an exceedingly delicate apparatus, constructed as above described, the window, *c'* (fig. 7), being of quartz. The candle used was the kind employed in gas photometry, and defined by Act of Parliament as a "sperm candle of 6 to the pound, burning at the rate of 120 grs. per hour." The distances were taken from the front surface of the pith when the luminous index stood at zero. They were in the proportion of 1 to 2 (140 to 280 millims.) to enable me to see if the action would follow the law of inverse squares and be four times as great at the half distance. No such proportion can, however, be seen in the results, the radiant source possibly being too close to allow the rays to fall as if from a point. The figures given are the means of a great many fairly concordant observations. Where a dash rule is put I have tried no experiment. The cipher 0 shows that experiments were actually tried but with no result.

The sensitiveness of my apparatus to heat-rays appears to be greater than that of any ordinary thermopile and galvanometer. Thus I can detect no current in the thermopile when obscure rays from copper at 100° C. fall on it through glass; and Melloni gives a similar result.

(To be continued).

ESTIMATION OF POTASSIUM AS ACID TARTRATE.*

By P. CASAMAJOR.

(Concluded from p. 233.)

If we should be in entire ignorance of the quantity of potassium in a compound to analyse, we should take a large quantity of tartaric acid, not more, however, than three times as much as the quantity of material weighed for analysis, as the monosulphide, which is the compound having the greatest percentage of potassium, has 71 per cent, which, multiplied by 4, gives 2.84. The next in order, potassic hydrate, has nearly, but not quite, 70 per cent.

To return to the 10 c.c. of decinormal solution, we may note that they contain 47 centigrams. of potassa, corres-

* Read before the American Chemical Society, September 7, 1876.

ponding to 39 centigrms. of potassium. We may then weigh approximately 2 grms. of tartaric acid, which is a little less than six times the quantity of potassium to be precipitated. This acid is dissolved, and added to our 10 c.c. of decinormal solution. The liquid should now be stirred sufficiently to make a thorough mixture of the solutions of potassa and tartaric acid. The crystals begin to deposit almost immediately, and the deposition increases for about five or six minutes, when it stops, and the liquid clears up. Alcohol should now be added to increase the precipitate. This addition, however, requires a few words of explanation.

As the result of numerous estimations of potassium in compounds of various kinds, I have found it advantageous to add, at first, only a small quantity of alcohol, a volume about one-tenth of the liquid in the beaker-glass. After this addition the liquid should be stirred sufficiently to effect a thorough mixture, and then be allowed to rest five or six minutes, when the liquid above the precipitate becomes clear once more. Finally, the rest of the alcohol should be added, a quantity sufficient to make the whole liquid in the beaker-glass contain at least 60 per cent of alcohol in volume. The liquid in the beaker should be stirred up once more, and after becoming clear it should be thrown on a filter.

To ensure in an easy manner a quantity of alcohol equal to 60 per cent of the total volume of liquid, I mark on the side of a beaker-glass a line corresponding to 50 c.c., which is easily done with a file, previously moistened with petroleum or spirits of turpentine to prevent the abrasion from cracking the glass. 50 c.c. are quite sufficient when we take 1 gm. of material for analysis. The volume of the beaker-glass should be at least 200 c.c. This volume of 50 c.c. is for the solution in water before adding alcohol. In the case we have on hand, we have dropped 10 c.c. of decinormal solution of potassa in a glass, and added a solution of tartaric acid. We may now add water up to the mark indicating 50 c.c.

On the other hand, we have strong alcohol—say, of 93½ per cent—which is the strongest common alcohol found in the market, and which is sold under the name of 95 per cent alcohol. I have no intention of giving rules for mixtures of alcohol and water, which are familiar to most chemists. In this case I will call your attention to this—that if you add 100 c.c. of 93½ per cent alcohol to the 50 c.c. of liquid in the beaker-glass, the result will be 150 c.c., and if we divide 93½ by 150 the result, 62·3, will be the strength of alcohol required.

After adding about 10 c.c. of strong alcohol to the 50 c.c. of solution in our beaker-glass, we finally add the rest of the 100 c.c. After the deposition of crystals has stopped, the contents of the beaker are thrown on a filter.* The liquid that filters through gives a distinct red colour to litmus paper. The precipitate on the filter should now be washed with alcohol of 60 per cent until the filtered liquid ceases to show a red colour with litmus paper. The precipitate after this is ready to be washed down into a beaker-glass to be tested with potassa, after the liquid in the glass has been sufficiently heated and coloured with litmus. The glass containing cream of tartar in water is placed under a burette, and, if the operation has been carefully conducted, it will take exactly 10 c.c. of the decinormal potassa solution to turn the liquid in the beaker-glass from red to blue.

The condition of a solution containing only potassa and water is one that very rarely, if ever, presents itself in chemical analysis, and we have in the next place to ascertain the influence of bodies which are usually found in combination, or in a state of mixture, with potassium.

If we drop 10 c.c. of a decinormal solution of potassa in a glass, and add a few drops of solution of litmus, we will be able to find the quantity of sulphuric acid, added drop by drop, which will neutralise the 10 c.c. of potassa.

After doing this, if we add as before 2 grms. of tartaric acid dissolved in water, a very slight precipitate will be obtained, even after standing for hours, and however much the liquid may be stirred, or whatever quantity of alcohol we may add, the precipitate does not increase perceptibly. If, instead of stopping at neutrality, a sufficient excess of sulphuric acid is added, tartaric acid will not show the least turbidity after continued agitation and addition of large quantities of alcohol. Hydrochloric acid in the same circumstances behaves exactly in the same manner, as is also the case with nitric and phosphoric acids. From the behaviour of potassic bromide and iodide, when in presence of an excess of tartaric acid, we must conclude that hydrobromic and hydroiodic acids belong to the same category.

With all these acids, a quantity sufficient for neutralisation of the potassa gives a slight precipitate, while an excess prevents precipitation. In the first case, the precipitate produced can only take place by liberating a quantity of the acid in combination, and after a sufficient quantity of free acid has been formed further deposition is prevented.

The acids experimented on were powerful mineral acids, whose affinities for potassium are so great that, although the acid tartrate is more insoluble than any of their potassic compounds, they only yield a small portion of potassium to tartaric acid. If, therefore, a weaker acid than the tartaric was chosen to combine with potassium, it would not prevent the production of an abundant deposit of acid tartrate. Acetic acid naturally suggested itself, and, on being tried, was found incapable of preventing this precipitation. Here, then, was our way out of the difficulty.

Before describing the manner in which this property of acetic acid was utilised, we must, for the better understanding of the subject, state that salts of sodium in a solution containing 60 per cent of alcohol do not prevent the precipitation of cream of tartar. The sulphate, the nitrate, the chloride, iodide, and bromide, the tartrate, and acetate seem equally powerless to prevent the formation of the precipitate. This is an important point, as by means of soda or its carbonate we may separate the bases that accompany potassium and ammonia, whose acid tartrate is very insoluble, and may in presence of soda be driven off by heat.

The property that acetic acid possesses, of allowing the complete deposition of cream of tartar to take place, suggested at first the following process:—Given a compound containing potassium, phosphoric acid, if present, would be separated as ammonio-magnesian, as tricalcic, or in any other convenient phosphate. The volatile acids could be driven off by excess of sulphuric acid and heat until fumes of sulphuric acid began to appear. Sulphuric acid could afterwards be precipitated with acetate of barium, thus leaving acetic acid as the only acid in the solution, in combination with all the bases.

This process is simple in theory, but long, and altogether detestable in practice. An analysis was already begun on this plan, when another, much more simple and convenient, suggested itself, which gave on trial the most satisfactory results. This process consists in adding to the compound to be analysed, if it contains a strong mineral acid, a certain quantity of acetate of sodium and, afterwards, tartaric acid. The effect of adding acetate of sodium is that if a strong mineral acid is in excess it forms a sodium salt by acting on the acetate, and liberates a corresponding quantity of acetic acid. When tartaric acid is afterwards added, and a quantity of acid tartrate is precipitated, the strong mineral acid set free reacts on the acetate, and acetic acid is again liberated. This action goes on until all the potassium has been precipitated as acid tartrate, and all the strong mineral acids originally combined with potassium have been combined with sodium, and a corresponding quantity of acetic acid has been set free.

The quantity of acetate of sodium that I usually add is equal to the quantity of tartaric acid. The theoretical

* When soda is present in the solution it is expedient not to delay too much in throwing the precipitate on a filter to avoid errors in the result. I propose in a future communication to examine this question.

quantity necessary is 55 per cent of the quantity of tartaric acid, but I always obtain excellent results by using equal quantities; the excess does no harm.

This action of acetate of sodium, in promoting the precipitation of cream of tartar, is one of importance in testing for potassium qualitatively. In our chemical books we find directions for precipitating potassium from its compounds by means of tartaric acid, as if it was a difficult and delicate operation. An addition of acetate of sodium in conjunction with tartaric acid, and a discreet use of alcohol, will give indications of potassium in a few minutes, even when present in small quantities.

To give an example of analysis of potassium, let us take a sample of chloride, and weigh 1 grm. This is dissolved, and 2 grms. of acetate of sodium are added and dissolved. We now dissolve 2 grms. of tartaric acid, and add them to the mixture of potassic chloride and acetate of sodium. We note the total volume of liquid, and, after the deposition of acid tartrate has stopped, we add about one-tenth as much of alcohol of 93½ per cent, when a further deposition takes place. Afterwards, the remaining quantity of strong alcohol is added, which must be such that the total volume of alcohol is double that of the original aqueous solution. The precipitated cream of tartar obtained is tested, exactly as before, by a decinormal solution of potassa.

Instead of estimating the precipitate of acid tartrate volumetrically, it may be dried at 100° C., and weighed. The volumetric analysis is, however, preferable, apart from its rapidity and convenience, because by the action of alcohol some compounds, such as sulphates, may in certain cases be precipitated, but as they have not an acid reaction their presence would not interfere with the estimation by a titrated alkaline solution.

To enable me to verify the accuracy of the results obtained by this process of analysis, I have in all cases taken a stated volume of titrated solution of pure potassa, and I have added sulphuric, nitric, and hydrochloric acids, and varying quantities of sodium salts. The potassa dissolved to form a titrated solution was Tromsdrøff's potassa by alcohol, containing no soda. The acids leave no residue by evaporation, and can therefore contain no potassium.

By saturating 10 c.c. of potassa solution with sulphuric, hydrochloric, and nitric acids, the following results were obtained. The numbers represent the c.c. of the same potassa solution, which saturated the acid tartrate precipitated in each case:—

SO ₄ K ₂ .	ClK.	NO ₃ K ₂ .
10'00	10'00	9'90
10'05	10'05	9'85
9'90	9'85	9'95

In making these experiments it was of the utmost importance that my solution of potassa should be pure, but, in commercial tests, it matters little whether the standard alkaline solution be of potassa or soda, as both neutralise cream of tartar.

The process for the estimation of potassium which I have described is not always advisable, as the strength of alcohol required may in some cases interfere with the results. When a great many tests are to be made, as happens in a factory, and at the same time extreme accuracy is not required, the expense attending the use of so much alcohol may be worth consideration.

For 1 grm. of substance weighed for analysis 100 c.c. of strong alcohol are required, besides about 50 c.c. more for washing the precipitate. Altogether, we may calculate that the alcohol for every test costs about 10 cents. In testing the low products of sugar houses for potassium strong alcohol cannot be used, because they contain substances which become adhesive and unmanageable in presence of strong alcohol.

To explain the process that I have used in such cases, let me take once more 10 c.c. of titrated potassa solution in a beaker-glass, and add enough tartaric acid to precipitate the potassium. A certain portion will be deposited,

but another part, although converted into cream of tartar, will remain in solution. If the precipitate is thrown on a filter without the addition of alcohol, and if we free it from excess of tartaric acid by washing with water, a further loss will take place. If, instead of using pure water to dissolve the tartaric acid added to our 10 c.c. of potassa solution, and to wash the precipitate of acid tartrate left on the filter, we use a liquid incapable of dissolving cream of tartar the loss would be very much reduced. This we can easily do by using a saturated solution of acid tartrate. When the impurities on the filter have been removed by washing with this saturated solution, the last portion of this solution may itself be removed by washing with a small quantity of alcohol of 60 per cent.

There will then remain one cause of error, due to the water introduced with the 10 c.c. of titrated potassa solution, which may, with sufficient approximation, be considered as 10 c.c. of water. To estimate this quantity, we must use the table of Chancel already given, and if we suppose that the temperature of the liquid is 25° C., we shall find that at that temperature 100 c.c. of water will dissolve 67 centigrms. of acid tartrate, and therefore 10 c.c. will dissolve 67 milligrms., corresponding to 16½ milligrms. of potassa, and consequently to 0'35 of 1 c.c. of decinormal solution. If we have operated with care, we will find that we can account for the original 10 c.c. of potassa solution within one-tenth of a c.c.

The results, however, are not nearly so accurate when salts of sodium are mixed with the potassa solution, and there is always a deficiency in the acid tartrate precipitated. I found, however, that a small quantity of alcohol will in great part overcome this difficulty, but by using too much alcohol, as much as 10 per cent, the results are too high. After a great many experiments, I have been led to adopt 3 per cent as the strength of alcohol that gives the best results. The quantities of acid tartrate dissolved by 3 per cent alcohol at various temperatures are as follows:—

Temp. C.	100 c.c. of Water having 3 per cent of Alcohol will Dissolve Cream of Tartar. Grammes.
0	0'21
5	0'25
10	0'32
15	0'37
20	0'45
25	0'54
30	0'60
35	0'75
40	0'84

This alcohol of 3 per cent, saturated with acid tartrate, is used to dissolve the potassium compound weighed for analysis, to dissolve tartaric acid and acetate of soda, to dilute our solutions, and wash our precipitates. As the temperature of a laboratory need not vary during an operation, no error need result from the quantities of cream of tartar which alcohol of 3 per cent will take up at different temperatures.

Let us take a low sugar-house product to test for potassa, in the shape of a syrup of 42° B. Suppose we take 100 grms. of this, the quantity of water in our weighed sample will be 20'6 grms. To this we add a quantity of alcohol equal to 3 per cent, or 3'3 per cent of alcohol of 93½ per cent, which is seven-tenths c.c. We may now dilute our syrup of 42° B. with alcohol of 3 per cent until it is quite thin, and add about 5 grms. of tartaric acid if the low product is from cane-sugar, or about 20 grms. if a beet product. We should also add about the same quantity of acetate of sodium, and after allowing deposition to take place for about fifteen minutes, the precipitate may be treated as we have seen in other cases.

After the acid tartrate has been saturated by the titrated potassa solution, we should add to the result obtained by the burette, the quantity of potassa corresponding to the acid tartrate dissolved by the 20'6 c.c. of water which

accompany the 100 grms. of 42° syrup and the 0·7 c.c. of alcohol added, which are equal to 21·3 c.c. of alcohol of 3 per cent. If the temperature of the liquid at the time of filtration is 30° C., we will find in the table I have given that 100 c.c. of alcohol of 3 per cent will, at that temperature, dissolve 60 centigrms. of cream of tartar, and consequently 21·3 c.c. will dissolve 13 centigrms., which represent 324 milligrms. of potassa, which should be added to the result.

The process based on the use of weak alcohol, saturated with cream of tartar, is of older date than the process I first described. The results obtained are not uniformly satisfactory, for, although they are generally good, sometimes there will be errors of 24 or 3 per cent, which cannot be attributed to any cause that I could discover. These discrepancies induced me to try the other process, in which the solutions are made to contain 60 per cent of alcohol, and this has always given satisfactory results.

REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.*

By Dr. A. W. HOFMANN.

(Continued from p. 233.)

The Sulphur Industry of Sicily.

By Dr. ANGELO BARBAGLIA.

THE true home of sulphur is Sicily, where the deposits extend over a great portion of the island bounded on the south by the mountains Delle Madoni, and comprising almost the whole of the provinces of Caltanissetta and Girgenti as well as a part of Catania as far as Caltagirone, Rammacca, and Centuripe. Besides this there are isolated deposits at Lercara, in the province of Palermo, and at Gibellino, in the province of Trapani. The number of sulphur mines scattered in the above-mentioned provinces is very considerable. According to a statistical conspectus for the year 1872 the number exceeded 250, with a total yearly production of 1,861,700 metric quintals, requiring an outlay of 2,472,935 lire.

Province.	Annual yield in Metric Quintals. Average of 1869, 1870, and 1871.	Expenditure in Italian Lire.
Caltanissetta	781,400	1,264,390
Catania	175,300	326,700
Girgenti	826,200	763,645
Palermo	78,800	118,200
	1,861,700	2,472,935

According to the recent and highly interesting investigations of the mining engineer, Mottura, published in 1871, Sicilian sulphur is a product of the tertiary formation, and is found in the upper miocene between foliaceous crystalline gypsum and massive limestone (calcinari); its associates are bituminous marl (tufo) and gypsum. The sulphuriferous deposits (veins, courses, beds) vary exceedingly in inclination, thickness, extent, and in richness. In these deposits and on their outer boundary, there is invariably found a granular, friable, whitish rock consisting chiefly of gypsum. The miners of the island name this rock *briscale*, and suppose that from the purity and thickness which it displays on the surface they can infer the richness and extent of the sulphur deposits. The ores are divided into three groups—

	Real Percentage.	Yield.
1. Richest	30—40	20—25
2. Rich	25—30	15—20
3. Ordinary	20—25	10—15

* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

Prospecting for Sulphur.—The existence of sulphur underground may be almost always concluded from characteristic indications on the surface. As such the *briscale* is especially regarded, and where it crops out to daylight it is as a rule certain to lead to deposits of sulphur. The occurrence of siliceous limestone and of sulphur springs are regarded as favourable indications. The first operation consists in driving strongly sloping adits, known by the native miners as *buchi* or *scaloni*. The latter name refers to the circumstance that they are laid out in stair-like flights, which are distinguished as *sani* and *rotti* according as they run on in a right line, or turn off at an angle.

(To be continued.)

ON A MODE OF GENERATING SULPHUROUS ACID FOR USE AS A DISINFECTANT, &c.

By THOMAS W. KEATES,

Consulting Chemist to the Metropolitan Board of Works, &c.

FROM the remotest time burning sulphur has been employed to fumigate and purify infected air, and to destroy fermentative and putrefactive action. There is no agent more powerful in its effects than this. Unlike chlorine, it not only acts as a disinfectant or destroyer of disease-germs and of the results of putrefaction, but it is also a powerful preservative agent, and, like carbolic acid, is a preventive of chemical changes in dead organic matter of every kind.

Although the value of sulphurous acid is thoroughly understood, its use is necessarily limited by the difficulty which exists in the way of producing it in a form in which it can be readily applied. The ordinary method of generating it by burning sulphur is cumbrous and very uncertain, owing to the difficulty of keeping up the combustion; there are also many situations in which the process cannot be carried on at all, and under the best circumstances it is inconvenient and but little under control. The evolution of the gas from its solution in water is scarcely more convenient, while it is much less effective; indeed, it may be said that there is no ready, convenient, and easily controllable way of producing this valuable agent in use at present; and this is the more remarkable when it is considered what a ready and simple means we really have at hand for this purpose.

Most of the readers of *The Lancet* are no doubt familiar, at least theoretically, with the substance called bisulphide of carbon. This is a compound of one atom of carbon with two atoms of sulphur (CS₂); it is a dense, mobile liquid, heavier than water, and intensely inflammable, burning in the air like spirit of wine. During combustion the constituents of the bisulphide combine with the oxygen of the air, producing sulphurous and carbonic acid gases; but as 100 parts contain, by weight, as much as 84 parts of sulphur, which will give, in burning, 168 parts of sulphurous acid, it will be seen that the volume of this gas from a given quantity of bisulphide greatly exceeds that of the carbonic acid, and is comparatively very large. Suppose the above quantities to be in grains: as 100 cubic inches of sulphurous acid weigh 68·5 grs., the 168 grs. will measure upwards of 245 cubic inches, or about one-seventh of a cubic foot, which is the volume of sulphurous acid obtainable from 100 grs. of bisulphide.

The bisulphide of carbon can be burned in a common spirit lamp, and in that case the products are sulphurous acid and carbonic acid only, in relative proportion to the atomic composition of the bisulphide, as I have stated; but by a modification of the method of burning, the amount of sulphurous acid produced in a given time can be regulated to any desired extent.

It is a property of the bisulphide of carbon to dissolve in fat oils and hydrocarbon liquids, such as petroleum; so by mixing it with any one of these liquids and burning

the mixture in a properly constructed oil or petroleum lamp, sulphurous acid will be generated with the other usual products of the combustion of such materials, and in proportion to the quantity of bisulphide present in the mixture of combustible liquids; any proportionate quantity of sulphurous acid can in this way be thrown into an atmosphere, and the action may be continued for any length of time.

As the sulphurous gas is generated *pari passu* during the combustion of the bisulphide, it diffuses itself in the air, which in a short time will become completely impregnated with it. In a room containing about 1300 cubic feet of air it was found that by burning 280 grs. of the bisulphide the atmosphere was so far charged with sulphurous acid that it was impossible to remain in the room for more than a few seconds. In five minutes after the lamp was lighted litmus paper began to be reddened at some distance from it; in ten minutes the air had become very oppressive, and the litmus paper was reddened in the extreme corners of the room; in fifteen minutes the air was so charged with the gas that it could scarcely be breathed, and in twenty minutes it was unbearable. In that time, as I have said, 280 grs. of bisulphide were consumed in a simple single-wick lamp.

Sulphurous acid generated in this manner can be applied with facility to the disinfection of any place or object. In the case of rooms in which infectious or contagious disease has prevailed, it is only necessary to light the lamp and allow it to burn until the atmosphere has become impregnated with the gas to any desired extent, and then to remove or extinguish it just like a common spirit lamp. In the simple form of apparatus which I suggest for this purpose, the lamp is enclosed in a metal case, about 3 inches in diameter and 8 or 9 inches high, furnished with holes near the bottom for the admission of air, and others in the top for the emission of the sulphurous gas. This can be conveniently moved about, and placed, while the lamp is burning, in almost any locality. receptacles for infected clothing, or the clothes or linen used in connection with disease, or carriages which have conveyed fever or other patients, can be thoroughly purified without difficulty and with very little trouble. For the disinfection of ships, too, the lamp is particularly suitable, as it can be carried into the remotest part of a ship and burned without the least danger, and with the certainty of effecting its object completely.

It must be observed that the bisulphide of carbon is extremely volatile, having its boiling-point as low as 110°F. ; it is therefore necessary that the lamp in which it is burned should be furnished with a well-fitting screw-cap, to prevent the liquid from evaporating, and at the same time to keep its peculiar odour from escaping. This odour is often very nauseous, but the bisulphide is now manufactured by Messrs. C. Price and Co., of Thames Street, so pure, that it possesses very little smell, and can be used without the least inconvenience.—*The Lancet*.

Printing-House Square.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

November 2nd, 1876.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidate was elected a member of the Society:—G. Waldemar von Tunzelmann.

M. JANSSEN made a brief communication, in French, with reference to a method which he has proposed to the Académie des Sciences for ascertaining whether planets really exist between Mercury and the Sun. After mentioning the importance of photography from an astronomical point of view, he explained his reasons for hoping

that a series of solar photographs—taken regularly at intervals of about two hours, at a number of places on the earth's surface—would enable us to determine this question which is now agitating the scientific world, since any spots which crossed the sun's disk would be at once registered. As it is necessary that such observations be made at several places and in several countries, M. Janssen hopes that other countries besides France will ere long arrange to have such a series of observations taken, and he considers that in a few years the circumsolar regions would thus be explored with a certainty which could not possibly be attained by any other method. He exhibited some of the original photographs taken in Japan of the transit of Venus, and explained the advantage of placing a grating in the focus of the camera in order to eliminate distortion.

MR. CROOKES showed the spectrum of a small specimen of chloride of gallium which he had received from its discoverer, M. Lecoq de Boisbaudran. The discovery of this metal is of peculiar interest, as M. Mendeleef had previously, from theoretical considerations, asserted it to exist, and had also correctly given some of its chemical and physical properties. The most prominent line in the spectrum was a bright line in the blue, somewhat more refrangible than that of indium.

MR. LODGE briefly described a model he has designed to illustrate flow of electricity, &c., which is fully explained in a paper in the *Philosophical Magazine* for November, and he showed how similar considerations can be applied in the case of thermo-electric currents. The model in its simplest form consists of an endless cord passing over four pulleys, and on one side of the square thus formed it passes through a series of buttons held in their positions by rigid rods or elastic strings, according as they represent layers of a conducting or non-conducting substance. When considered in connection with thermo-electricity the buttons are assumed to oscillate on the cord, and if they move in one direction with greater velocity than in the other, the cord will tend to move in the former direction. Now, at a junction of copper and iron, since the metals have different atomic weights and their kinetic energies are equal, the velocities must differ on each side of the junction, and an unsymmetrical oscillation of the molecules must ensue, analogous to that assumed by Mr. Stoney to take place in Crookes's radiometer, and the cord, or electric current, will advance when two junctions are at different temperatures. Mr. Lodge showed experimentally that for a given difference of temperature the maximum thermo-electric current is obtained when one of the junctions is at 280°C. , and beyond this point the amount of deflection decreases. This fact led Sir W. Thomson to discover the convection of heat by electricity; that is, if we have a circuit composed of copper and iron, and one of the junctions is at the above temperature, the current, in passing from hot to cold in the iron or from cold to hot in the copper, absorbs heat. This fact was experimentally illustrated by Mr. Lodge. A strip of tin plate is symmetrically bent so as to nearly touch the two faces of a thermopile, and is heated at the bend by steam passing through a brass tube on one side (not end) of the thermopile, and kept cold by a current of water on the other side. As the arrangement is symmetrical no current is found to pass through the thermopile, but when a powerful voltaic current passes through the strip of metal a reversible deflection of the needle is observed, in accordance with the above law.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 17, 1876.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

MR. BAXENDALL drew attention to a paper, "On the Protection of Buildings from Lightning," read by Prof. J. Clerk Maxwell at the late meeting of the British Associa-

tion at Glasgow, and stated that the system of protection recommended by the Professor, and which he appears to have regarded as new, was suggested, and its adoption strongly advocated, nearly forty years ago by the late Mr. Sturgeon, whose many valuable contributions to electrical and magnetical science seem to have been strangely overlooked by recent investigators and writers. The paper in which the system was first described was read before the London Electrical Society on the 7th of March, 1838, and an abstract of it was published in the second volume of the "Annals of Electricity." There is, however, one important difference between the two systems. Mr. Sturgeon considered it necessary that the copper sheathing or covering of a protected room or powder magazine should be well connected with the ground; but Prof. Maxwell is reported to have stated that "there would be no need of any earth connection. They might even place a layer of asphalt between the copper floor and the ground, so as to insulate the building." It is obvious, however, that if the magazine were struck by lightning a disruptive discharge through the layer of asphalt would in all probability take place, which might rupture the copper sheathing, and thus ignite the contents of the magazine; but by the adoption of Mr. Sturgeon's plan an accident of this kind could not occur.

Remarkable Meteor.—The PRESIDENT said that on Tuesday, the 15th of August last, whilst standing on the deck of the packet in Douglas Bay, in the Isle of Man, he observed one of the most brilliant meteors that he had ever seen. At about 35 minutes past 9 o'clock p.m., Greenwich time, he was looking towards the west, when he observed a body, apparently larger than the planet Jupiter, in the S.E., at an elevation of about 30° with the horizon, traversing the heavens at first in a nearly horizontal direction, then gradually declining, and finally disappearing by a steep curve to the N.N.W. When first observed it appeared to be of a yellowish colour, but it changed to a greenish blue before it sank out of sight. During its last stage it reminded him of a large Roman candle, and from its great brilliancy appeared to be not very far from the place where he stood, but he observed no signs of its bursting, and it left little trace of a luminous track behind it. The speed at which it travelled appeared to be less than that of most meteors which he had observed.

This meteor appears to have been observed by several parties, for Mr. J. P. Norris wrote to the *Times* from Abbey House, Bristol, under date of August 15—"A brilliant meteor has this moment fallen due west of this house. It first appeared in the neighbourhood of Arcturus, then seemed to burst, and trail light of rainbow colour, and was visible to near the horizon slanting towards the north. Its distance cannot have been great, for we saw it throughout two-thirds of its course against a dark cloud. It may have fallen, therefore, in the neighbourhood of Clevedon." A correspondent, writing from Further Barton, Cirencester, on Wednesday, says—"At about 9.30 yesterday evening (15th) a magnificent meteor was seen from this place, passing slowly across the north-western heavens about midway between Arcturus and the horizon. The colour was vivid pale green; it left a greenish wake behind it, and burst with brilliant scintillations of whiter light;" and another says—"At 9.30 last night, Greenwich time, I saw the finest meteor or fire-ball that it has ever been my fortune to observe. It passed just below E. Bootes, and travelled northwards in a descending direction between A. Canes Venatici and the large cluster in Coma, rather nearer the latter. It exactly resembled the globe of fire projected by a Roman candle; the colour was of a brilliant yellow, and then after changing to a vivid green the meteor disappeared. The ball was pure, and unattended by luminous track."

He gave the above particulars to show how observers were deceived as to the distance of meteors. The party who observed the one on the 15th of August near Bristol thought that it fell near Clevedon, while he (the President)

seeing it at Douglas, 220 miles N.N.W. of that city, imagined it at no very great distance from him. He brought the matter before the Society for the purpose of enquiring whether the meteor had been observed by other parties, especially residents in Belfast or Glasgow, in order to ascertain if it had been seen westwards of those two places.

Mr. A. M. WORTHINGTON described the changes which take place in the forms of drops of liquids falling vertically on a horizontal surface, and exhibited the apparatus used in his experiments, and also a series of smoked glass plates bearing the impressions produced by the falling of drops of liquids from different heights.

NOTICES OF BOOKS.

Familiar Letters on the Mysteries of Nature and Discoveries in Science. By Dr. T. L. PHIPSON. London: Sampson Low, Marston, Searle, and Rivington.

In this book the reader is introduced to a number of subjects lying somewhat away from the beaten tracks of science, and often overlooked in our popular treatises. The author discusses the *ignis fatuus*, electric fogs, the chemistry of the ocean, the science of sleep, plant motion, firestones, atmospheric electricity, lightning-prints, earthquakes, luminous animals, aërolites and inhabited planets. These topics he handles in a suggestive manner; he places facts in a novel light, and often shows the questionable character of our stereotyped explanations of natural phenomena. The Will-o'-the-wisp, he tells us, is, in England, most common "in the peaty districts around Port Carlisle, in Cumberland;" and on the Continent, "in the damp valleys between the pretty little university town of Marburg and that of Cassel, and more certainly still in the grave-yards outside the town of Gibraltar." He points out that the phenomena must be clearly distinguished from the "more or less stationary flames of ignited naphtha springs," common in the East and in Italy, and occasionally visible in Herefordshire and Lanarkshire. From his own observations, as well as from the evidence of Dr. Dereham, he rejects the view of Ray, Willoughby, Kirby, and Spence, who attributed this phenomenon to swarms of luminous insects. These, he declares, "rise far higher in the air than does the Will-o'-the-wisp, and present the appearance of hundreds of little specks of light." He ascribes the flame to an escape of marsh gas, through which a small quantity of phosphuretted hydrogen is diffused, and considers that wherever the wisp manifests itself, there lies the corpse of some animal. This view agrees well with the provincial name of "corpse-candle," and with a number of popular traditions. Folklore, however, records also cases where the spectator of a wisp has received a sudden blow or shock, and this, as the author suggests, points to electric phenomena of a nature perfectly distinct from the true wisp, and closely related with the fire of St. Elmo.

On fogs—a subject of peculiar though painful interest to dwellers in London—Dr. Phipson gives much curious information. He even suggests a method for their dispersal. "In order to disperse the dense electro-positive London fogs it would be necessary to supply them with an abundant source of electro-negative electricity more quickly than the earth usually supplies it. In the present state of electrical science I imagine such a thing to be far from impossible." Dry electro-negative fogs are supposed, on imperfect evidence, to be connected with the appearance of certain diseases. "A dry blue mist of this kind was noticed in London, in 1832, 1854, 1866, during the period of cholera; and the yellow kind has been known to accompany epidemics of scarlatina." Such fogs are not dispersed by rain and wind. On the evening of July 24th, 1872, "when a tolerably stiff breeze from the S.E. was blowing, I found that it was impossible to see the tree

on the towing-path from Putney Bridge." The author has never been able to obtain decided indications of ozone during the prevalence of an electro-negative fog, "but sometimes electro-positive fogs have shown no ozone either in spite of the strong suffocating odour which often accompanies them. This would argue in favour of the existence at certain periods of antozone in the air—a fact which it would be exceedingly interesting to place beyond a doubt."

In the chapter on the "chemistry of the ocean" the curious fact is noticed that one half of all the known elementary bodies have been recognised in sea-water. We learn also that the waters of the Caspian, which has no known outlet, are yet, unlike those of the Dead Sea and of the Great Salt Lake, less salt than the Ocean. We turn next to a letter on the "science of sleep, somnambulism, and anæsthesia." Here, *apropos* of a certain theory propounded to account for the periodical recurrence of sleep, we find the following important and most truthful remark:—

"It is a notorious fact that medical men, whose knowledge of chemistry is necessarily, in most cases, somewhat limited, are very fond of getting behind a chemical screen when confronting a difficult physiological problem; in like manner certain chemists, whose acquaintance with mathematics is of a most elementary nature, are prone to shield their incapacity of dealing with troublesome facts by erecting screens of mathematical formulæ, or abstruse chemical formulæ, as nearly as possible allied to them, which they create for the occasion, losing sight of nature altogether, and dealing, like our sensation-novel writers, with the products of their imagination." We fear that certain neo-chemical luminaries will be apt to exclaim with Costard, "me," "still-me" as they read this passage.

In a chapter on the marvels of applied electricity Dr. Phipson remarks that "Man's command of fire at once distinguished him from the rest of animated creation. In the higher classes of apes and monkeys, for instance, although we do not observe so great a dread of fire as we see manifested by quadrupeds, yet there is not a monkey, however highly organised, that has the slightest power over fire. I recollect a scene narrated by the captain of a ship that was wrecked on the coast of Madagascar. The crew made a large fire in the woods at night, and having withdrawn from the blazing embers they secreted themselves in order to observe what the monkeys would do with the fire. As soon as the sailors had retired, numbers of these agile beings leaped from the boughs and approached the fire, the warmth and glare of which they appeared to enjoy. They approached nearer and nearer as the fire gradually burnt out, but not one had the intelligence to throw in a single bough to keep the fire alive, though numerous logs and sticks were scattered upon the ground." The only fault we have to find with this narrative is that there are no monkeys in Madagascar, whilst the lemurs, which, to some extent, take their place, are but ill-organised for throwing logs or sticks upon a fire.

According to Dr. Léning, M. de Romas, and Arago, the problem of transforming thunder clouds, and thus preventing the formation of hail has been solved, and all that is required is that our knowledge should be reduced to practice. The damage done by hail in the south of France in a single storm has been known to amount to a million sterling. An interesting application of electricity is the rendering sea-water, &c., potable by passing through it a current from the battery. The author has not unsuccessfully experimented on this question at Ostend.

In his letter on earthquakes, Dr. Phipson remarks that in his opinion "enough stress has not been laid upon the constant presence of sulphur among the products of volcanic action . . . In earthquakes we have constantly a suffocating smell of sulphur or sulphurous gas, and the same occurs in intense thunder storms, especially when the lightning strikes an object on the earth's surface. We have not yet the key to this enigma." In pointing

out the imperfection of our knowledge concerning the causes of earthquakes, Dr. Phipson indulges in a strange, and we cannot help saying a most unscientific remark:—"What a field is here open to our young geologists if they can be persuaded to abandon collecting fossils and petrifications!" Why we should abandon the observation of any class of natural objects is to us a mystery.

There is a very curious chapter on "lightning-prints." The term needs a little explanation. Occasionally it happens that when men or animals have been struck by lightning, and especially if killed, peculiar impressions have been left upon their bodies, which seem to be the impress of some adjacent object. Many of the accounts of phenomena of this kind are either altogether mythological or much exaggerated. Thus, according to the Abbé Lamy, "on the 18th July, 1689, lightning struck the tower of the church of St. Sauveur, at Langy, in France, and printed upon the cloth of the altar some Latin words of a prayer book. The words *Qui pridie quam pateretur*, to the end of the prayer were all reproduced, with the exception of *Hoc est corpus meum* and *Hic est sanguis meus*, which in the book were printed in red ink." In 1786, Leroy, a member of the French Academy of Sciences, announced that Benjamin Franklin had frequently told him, some forty years previously, the case of a man who, whilst standing at his door during a thunder-storm, saw the lightning strike a tree opposite to him. It was afterwards discovered that a reversed image of the tree was indelibly imprinted upon the breast of that man. A Mr. James Shaw relates a case which had occurred in 1812. Six sheep feeding in a small pasture surrounded by a wood at Combe Bay, near Bath. They were killed by a flash of lightning, and when flayed "the inside of each skin bore a very faithful image of the surrounding landscape."

The following case is fully authenticated:—In 1836, a young man was killed by lightning near Zante. He had around his body a belt containing some gold pieces, and the images of some of these were indelibly printed upon his right shoulder. The impressions produced, however, were not fac similes of the gold pieces, but circles of three different dimensions, corresponding exactly in size with the three kinds of pieces of money in the belt. Impressions appear also to have been produced in some cases upon inanimate bodies. Thus, according to Professor Andreas Poey, lightning engraved upon the dry leaves of a palm tree in Cuba the representation of some trees growing at the distance of 340 yards. Further observation is here wanted and may both extend our knowledge of the properties of electricity and lead to useful application.

Treating of "life on the earth" the author shows that its correlation with the physical "forces," if modern word splitters will allow us the use of the term, is incomplete. Life, indeed, may produce heat, light, electricity, and chemical action, but it has never, within our observation, been produced by them. Turning to the duration of life he considers, quoting the well-known case of Cornaro, that sobriety is its most essential condition. It must, however, be remembered that Cornaro does not appear to have been a hard worker. The quantity of food sufficient for a man whose days are spent in the *dolce far niente* must necessarily be quite insufficient for persons whose brains or whose muscles are kept in constant exertion. We do not believe that in these days "the generality of people eat far too much."

The proportion of the time of gestation and of the subsequent growth of the young animal to the duration of its life is next considered. But it is an exceedingly difficult thing to determine the average natural life of an animal in a wild state. In captivity or domestication so many disturbing influences come into play that the result is of doubtful value. And, supposing that the time of gestation bears any fixed proportion to the normal period of life, is there any *a priori* reason for affirming that the same ratio must prevail in all the different divisions of the animal

kingdom? As to the time of growth we know already that it bears no constant proportion to the duration of life. In mammals and birds the period of maturity is much longer than the period of growth; but in many insects, e.g., the goat-moth and the cockchafer, it is very much shorter. This chapter of his work Dr. Phipson concludes with the following passage:—

"Those men who abide by experiment and observation, and who simply record their scientific experience, are not likely to shock the religious opinions which govern so many of their fellow creatures; it is otherwise with those who indulge in speculative theories and who attempt to explain everything in their manner. *These are only bigots and fanatics in another form, and they deserve the odium which they draw upon themselves from the opposite extreme of humanity.*"

We cannot agree with this passage; observations and experiments "pure simple" will arouse persecution the moment their results are seen to clash with ecclesiastical tradition. In the very next chapter Dr. Phipson declares:—"When the latter (Galileo) began to give the world the benefit of his observations he was most villainously persecuted." With theories, geological, biological, or astronomical, theologians have, as such, no right to interfere. In a manner strictly analogous physicists, geologists, and the like have no claim to dogmatise on religious questions. We have always denounced every attempt made by either body to exceed its boundaries, but we cannot forget that the first transgression of this nature was made by the theologians.

But there can be no need for us further to multiply either extracts or comments. Whoever has followed us so far will admit that Dr. Phipson's "Familiar Letters" abound in facts not generally known and in interesting reflections. Though popularly written, in the sense of being free from the cumbersome terminology now so much affected, they may be advantageously read by the professed man of science as well as by the person of ordinary culture, and will certainly set both thinking.

CORRESPONDENCE.

ESTIMATION OF POTASSIUM BY MEANS OF ACID TARTRATE.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 231) you publish the first portion of a paper by Mr. P. Casamajor, on the "Estimation of Potassium by means of Acid Tartrate." He claims special applicability for his method to the estimation of potash in the syrups of sugar-houses. In the *Sugar Cane* for October 1st, 1874, I inserted a short paper, for the use of foremen or others employed in such houses, containing a description of the same plan of working, adapted to the facilities and time at their command. With the platinic chloride at our call in the laboratory, it seemed useless to attempt any elaboration of the tartaric acid mode of estimation, which may, in its own sphere, be a useful aid to those seeking for a rapid means of assaying the probable ash in syrups. In the same number of the *Sugar Cane*, or the previous one, there is a paper by Mr. Casamajor on the "Expansion of Sugar Solutions by Heat," so he could hardly be quite ignorant of the appearance of mine. I append a copy of my paper.—I am, &c.,

ROBERT FRAZER SMITH.

Glasgow, December 2, 1876.

"The following is the description of an easy and fairly correct practical method for the estimation of potash in syrups and sugars. It is assumed, as a general rule, that two-fifths of the weight of ash present in sugars and

syrups, as found by incineration, is potash, and in the majority of instances this assumption is a correct one. It is almost impossible for many persons employed in sugar-houses to find time or opportunity for an ash estimation by the ordinary method, but a correct knowledge of the potash percentage—besides its value as an adjunct to the Duncan and Newlands process—affords also the means of finding the total ash. The potash percentage is readily found thus by any intelligent workman:—Weigh 100 grms. of syrup in a beaker; add 30 c.c. alcohol and 30 c.c. water, containing in solution about 15 grms. tartaric acid. Stir vigorously for a few minutes; then allow the mixture to rest for about half-an-hour. Collect the precipitate upon a tared filter, allow it to drain, then wash with other 60 c.c. mixed alcohol and water. Dry in a water-bath, and weigh. One-fourth of the precipitate is potash.

$$\frac{\text{Potash} \times 5}{2} = \text{total ash.}$$

"The following are estimations made by this method as compared with the ordinary ash estimations made in the laboratory:—

Ash found.	Potash calculated 2-5ths of Ash	Potash calculated from Acid Tartrate weighed.
5'16	2'06	1'94
5'44	2'17	1'83
6'33	2'53	2'43
7'63	3'05	3'61
8'26	3'30	3'62
8'19	3'27	3'69
6'83	2'73	2'74
6'17	2'46	2'23
7'12	2'85	2'97
4'70	1'88	1'81

"In the event of any doubt being entertained of the purity of the collected bitartrate, incinerate 5 grms. in a platinum capsule, boil the resulting black flux in water, filter and wash the carbon thoroughly, and titrate the filtrate in the usual way with normal acid. This could only be necessary when much lime is present in the syrup—a most unlikely thing to happen in this country.

"Greenock, August 15, 1874."

PROFESSOR WÖHLER.

To the Editor of the Chemical News.

SIR,—The leading members of the executive of the German Chemical Society in Berlin have nominated the veteran Prof. Wöhler President of the Society for the coming year.

I feel that the announcement will be hailed with delight by every chemist, and I beg you to allow me the opportunity of pointing out to such of our craft as are members of that excellent society that they are entitled to vote at the election of President; and that they should not neglect to give expression to the respect and admiration all must feel for the illustrious chemist by sending *without delay*, by post-card or letter, to the present President or one of the Secretaries of the Society, in Berlin, a short statement, signed and dated, to the effect that they give their votes in favour of Prof. Wöhler.—I am, &c.,

WALTER FLIGHT.

Savile Club, 15, Savile Row, W.,
December 6, 1876.

THE SOCIETY OF PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—I had hoped that I might be spared the necessity of following the example of the Treasurer and one of the Vice-Presidents of the Society of Public Analysts in resigning, before the expiration of my year of office, my position as President, and also my membership, in the

Society, but the occurrence of another in addition to several previous acts of irregularity in the performance of the secretarial duties, and the disapproval I entertain and have expressed, without effect, of these and of the manner in which the editorial duties have been conducted in connection with the Society, have caused me now at once to tender my resignation, and thus to express to the members of the Society my reason for so doing.—I am, &c.,

T. REDWOOD.

17, Bloomsbury Square, W.C., -
December 5, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Societe Chimique de Paris,
Nos. 8 and 9, November 5, 1876.

Decolouration of Indigo by Hydro-sulphurous Acid and by the Persulphide of Hydrogen.—M. E. Schaer.—It is generally admitted that the decolouration of indigo by these agents is due to its transformation into white indigo, and, in fact, mere agitation in the air suffices to restore the blue colour. But certain experiments seem to show that the decolouration is produced by the formation of a colourless molecular compound. For indigo decolourised by hydro-sulphurous acid is regenerated, not only by the action of air and oxidising agents, but also by decided reducing agents, such as sulphuretted hydrogen. Further, indigo bleached by the persulphide of hydrogen is restored by the action of sulphurous acid. These phenomena are explained by the decomposing action of sulphuretted hydrogen upon hydro-sulphurous acid, and of sulphurous acid upon persulphide of hydrogen. We may, then, admit that indigo combines with hydro-sulphurous acid and persulphide of hydrogen, forming colourless compounds, which are destroyed with liberation of the indigo by all agents capable of destroying either hydro-sulphurous acid or persulphide of hydrogen.

No. 10, November 20, 1876.

New Researches on Gallium.—M. Lecoq de Boisbaudran.—Already noticed.

Remarks of M. Boutlerow on a Note by M. L. Henry relating to the Fixation of Hypochlorous Acid upon Isobutylene.—M. Boutlerow remarks that M. Henry has merely confirmed his researches, conducted nine years ago.

Dissociation of the Bicarbonate of Soda at the Temperature of 100°; a reply to M. Gautier.—M. V. Urbain.—The author maintains, contrary to the opinion of M. Gautier, that if dried plasma is exposed to the temperature of 100° the bicarbonate of soda which it contains is not decomposed.

Stains Produced by Sulphocyanic Acid.—M. Pierre Miquel.—The author finds that sulphocyanic acid produces upon paper free from iron a carmine-red spot, which disappears spontaneously on exposure to the air, and more rapidly if a gentle heat be applied. Ammoniacal vapours destroy the colour immediately, and hydrochloric gas restores it. Thus a test-paper is obtained far more sensitive than litmus.

Nitro- and Amido-Naphthyl-Sulphurous Acids, and on their Derivatives.—P. T. Clève.—Not suitable for abstraction.

Correspondence from St. Petersburg, April 12, 1876.—W. Louguinine.—The second part of the eighth volume of the *Journal of the Russian Chemical Society* contains the following papers:—M. A. Zagoumeny has obtained diphenyl-carbinol by the action of alcoholic potassa upon benzo-phenon at 160° in sealed tubes. M. E. Wagner, on

behalf of MM. A. Zaytzeff and P. Sorokine, describes researches on the action of iodide of allyl and of zinc upon acetic ether. M. Menschoutkine communicates, on behalf of M. L. Lound, his studies on the transformation of cane-sugar when its aqueous solutions are heated. He finds that these solutions are inverted when heated to 100° in presence of air. If heated in the absence of air, or in presence of air perfectly purified, there is no transformation. Nitrogen and oxygen have no action; carbonic acid acts more fully than air. The transformation must be ascribed partly to the carbonic acid, partly to other substances in the atmosphere not yet determined. M. Menschoutkine, on behalf of MM. F. Wreden and Znatowich, announces that hexa-hydrocymen and decahydro-naphthalin are obtained in the action of hydriodic acid upon naphthalin. The same chemist communicates, on the part of M. G. Fudakovski, an examination of saccharine matters containing galactose. M. Beilstein, on behalf of Dr. Cech, communicates a notice of the colouring power of viridic acid, which he recommends as a colour for esculents (a very old suggestion). M. A. Borodine communicates, on the part of M. Schallfeiff, researches on the cerotic acid extracted from bees'-wax. The acid obtained by Brodie's method is a mixture. M. Idanoff communicates researches on diethyl-methyl-acetic acid, an isomer of cenanthylic acid. There is, further, papers on the electrolysis of the aqueous solutions of oxalic acid, by M. N. Bunge; on the differences observed between starches of different origin when submitted to diastatic action, by M. A. Dobroslavine; on the action of the saliva on divers kinds of starch, by Dr. Georgiefsky; and on the action of iodide of allyl and zinc upon oxalate of ethyl, by M. Michel Zaytzeff.

Absorption-Spectra of different Colouring Matters and Metals of the Iron Group, with Applications.—This paper, which is taken from the *Berichte der Deutsch. Chem. Gesell.* (viii., 1246 and 1533), is incapable of useful abstraction.

Revue Universelle des Mines,
July and August, 1876.

Fermentation of Urine.—M. Leon Krafft.—This paper treats of the preparation of ammoniacal salts from the drainings of cesspools. These liquids are either mixed with sulphuric acid or filtered over sulphate of lime, the result being in either case the conversion of the volatile carbonate of ammonia into the fixed sulphate. The liquid, rendered limpid and clear either by settling or filtration, is evaporated down to one-tenth of its volume either over the naked fire, or by the "graduation" principle. It is then absorbed by a powder composed of turf, bone-black, mineral phosphate of lime, and baked gypsum.

Moniteur Scientifique, du Dr. Quesneville,
November, 1876.

Chemical Patents taken out in France during the Year 1875.—A list of the titles of patents.

Determination of Tannin.—G. Pouchet.—The author passes in review the processes known, and gives the preference to titration with permanganate in an alkaline solution.

On Rosolic Acid.—MM. Graebe and Caro.—Taken from *Liebigs Annalen*.

Contributions to a Knowledge of Rosaniline.—E. and O. Fischer.—From the *Berichte der Deut. Chem. Gesell.*, ix., p. 891.

Duchemin's Compass with Circular Magnets.—A commission of naval officers appointed to enquire into the merits of this invention has reported decidedly in its favour.

Preparation of Thallium.—Dr. R. Nietski.—The author is not satisfied with the method of Krause. He takes the chloride of thallium, moistens it with water slightly acidulated, and adds a few fragments of zinc. After a few days all the thallium is separated in a spongy

mass, which is carefully washed, and dissolved in hot dilute sulphuric acid. The foreign metals and the other impurities remain undissolved. A pure and concentrated solution of sulphate of thallium is thus obtained, from which the salt may be separated by crystallisation, and the metal may be obtained either by a galvanic current or by means of zinc.

Dyeing Aniline-Blacks.—M. Allard.—The author protests against the claim set up by M. Grawitz to be the first inventor of the process for dyeing aniline-blacks without exposure to air, the colour being due to the formation of double salts of aniline peroxidised by chlorates or chromates.

MISCELLANEOUS.

University of London.—The following gentlemen have passed the recent Second B.A. and Second B.Sc. examinations:—*Examinations for Honours (B.A. and B.Sc. conjointly); Mathematics and Natural Philosophy.*—First class. J. S. Morris, B.A. (Scholarship), St. John's College, Cambridge; J. F. Main, B.Sc., Trinity College, Cambridge. Second class. S. White, B.A., University College. *Chemistry (B.Sc. only).*—First class. J. K. Crow (Scholarship), Owens College. Second class. W. W. Jones, Magdalen College, Oxford. *Geology and Palæontology.*—First class. W. Hewitt (disqualified by age for the Scholarship), Royal School of Mines; J. K. Crow (Scholarship), Owens College; A. R. Willis, Royal School of Mines. Second class. J. Monckman, Yorkshire College of Science; A. E. Tovey, private study.

Royal Institution of Great Britain.—The following are the arrangements of the Lectures before Easter, 1876:—

Prof. John Hall Gladstone, Ph.D., F.R.S.—Six Lectures adapted to a juvenile auditory, on the "Chemistry of Fire;" on Dec. 28 (Thursday), 30, 1876; Jan. 2, 4, 6, 9, 1877.

Prof. Alfred H. Garrod, M.A., F.R.S.—Ten Lectures on "The Human Form; its Structure in relation to its Contour;" on Tuesdays, Jan. 16 to March 20.

Dr. C. R. Alder Wright, F.C.S.—Four Lectures "On Metals, and the Chief Industrial Uses of these Bodies and their Compounds;" on Thursdays, Jan. 18 to Feb. 8.

William Pole, F.R.S., Mus. Doc.—Six Lectures "On the Theory of Music;" on Thursdays, Feb. 15 to March 22.

Mr. Ernst Pauer.—Two Lectures "On the Nature of Music: the Italian, French, and German Schools;" on Saturdays, Jan. 20, 27.

Mr. J. A. Symonds.—Three Lectures "On Florence and the Medici;" on Saturdays, Feb. 3 to 17.

Prof. Henry Morley.—Five Lectures "On Effects of the French Revolution upon English Literature;" on Saturdays, Feb. 24 to March 24.

The Friday Evening Meeting will begin on Jan. 19, 1877, at 8 o'clock; the Discourse by Prof. Tyndall at 9 p.m. The succeeding discourses will probably be given by Prof. Huxley, Prof. Osborne Reynolds, Mr. Francis Galton, Prof. F. Guthrie, Mr. J. F. Moulton, Sir John Lubbock, Mr. Frederick J. Bramwell, and others. To these meetings Members and their friends only are admitted.

Early Closing amongst Chemists and Druggists.—A conference of chemists in the Notting Hill District, who were favourable to earlier hours of closing, was held on Friday last in the Mall Hall, the Mall, Notting Hill. Messrs. Johnson (Twinbrow), Westbourne Grove, Chas. Butler, Faulkner, Baker, Grosvenor, Long, H. Long, Drury, &c., attended, and also Messrs. E. Kennedy and F. A. Allen, Secretaries, Early Closing Association. The following resolutions were adopted:—Proposed by Mr. A. P. Baker, seconded by Mr. C. H. Grosvenor:—"That in the opinion of this meeting the business hours observed by the chemists and druggists of this neighbourhood are

unduly prolonged, and might be curtailed without inconvenience to the public or prejudice to the trade, whilst conferring great benefit upon employers and employed." Proposed by Mr. S. Drury, seconded by Mr. C. Butler:—"That the chemists and druggists present, being convinced of the benefits to be derived from the adoption of earlier hours of closing, hereby form themselves into a provisional committee (with power to add to their number) for carrying out the object of the meeting." Proposed by Mr. R. A. Johnson, seconded by Mr. J. R. Faulkner:—"That the foregoing resolutions be forwarded to the Press, and to the various chemists and druggists of the locality, with a view to their co-operation in the movement." The proceedings terminated with a vote of thanks to the Chairman. The next committee meeting is fixed for Wednesday, December 13, at the same time and place.

The Newcastle Institute of Mining and Mechanical Engineers.—We are glad to announce that this useful institute has lately received the honour of being incorporated by Royal Charter.

MEETINGS FOR THE WEEK.

MONDAY, 11th.—Society of Arts, 8. (Cantor Lectures.) "The History of the Art of Coach Building," by Mr. G. A. Thrupp. Lecture IV.—Ancient and Modern Travelling and Public Carriages of Europe.

— Medical, 8.
— London Institution, 5.
— Royal Geographical, 8.30.

TUESDAY, 12th.—Civil Engineers, 8.
— Photographic, 8.
— Anthropological Institute, 8.
— Manchester Literary and Philosophical, 7.

WEDNESDAY, 13th.—Society of Arts, 8. "A New Process of Printing a Number of Colours at one Impression," by E. Meyerstein.

THURSDAY, 14th.—Royal, 8.30.

SATURDAY, 16th.—Physical, 3. "An Experimental Contribution to the Theory of the Radiometer," by W. Crookes, F.R.S. "On a Capillary Electrometer," by Prof. J. Dewar, F.R.S.E.

TO CORRESPONDENTS.

E. H. Cook.—Received with thanks.

J. W. M.—Mr. Smith's letter renders the publication of yours unnecessary.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 890.

ON REPULSION RESULTING FROM RADIATION.—PART II.*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 242).

110. AN examination of this Table shows that the action is by no means confined to the rays usually called heat, *i.e.*, to the extreme- and ultra-red of the spectrum. The strong action obtained when the light is filtered through greenish glass and alum, or through ammonio-sulphate of copper, shows that luminous rays produce a similar movement of repulsion.

Unfavourable weather has prevented me from obtaining good quantitative results with the different rays of the solar spectrum; but I have tried numerous qualitative experiments which leave no doubt on my mind that any ray, from the invisible ultra-red to the invisible ultra-violet, will produce repulsion in a vacuum. The following is an experiment tried with the electric light. The spectrum was formed with a complete quartz train, no glass whatever being in the path of the rays. The purity of the spectrum was evidenced by the fact of the lines being sharp when thallium, sodium, or lithium was put between the carbon poles. The spectrum was so arranged that any desired ray could be thrown on to a lampblack pith surface, screens being interposed to cut off the action when desired. The torsion balance was similar to the one used in the last-named series of experiments (104), but was not quite so sensitive.

The extreme red rays were first brought into position. On removing the screen the luminous index moved 9 divisions on the scale. The screen being replaced, the index returned to zero. A solution of iodine in disulphide of carbon was now interposed, and the screen again removed. The repulsion was almost as strong as before, showing that this liquid was transparent to the ultra-red rays.

The iodine solution was then replaced by a clear plate of alum 5 millims. thick, and the screen removed; a very slight movement only took place. The iodine solution was then put in front of the alum plate, so as to subject the extreme red rays to a double process of sifting. No trace of action could be detected.

Whilst this double screen was in front of the pith disk, the spectrum was gradually passed along, so as to bring the rays, one after the other, into position. No effect, however, was produced, showing that alum and iodine solution practically obliterate the whole of the spectrum.

The alum plate and iodine cell were now removed, and the green of the spectrum (the thallium line) was brought into position. The luminous index moved 6 divisions. The plate of alum cut off only a small amount of this action, but the iodine cell brought the index to zero. This is a proof that the action in this case was not due to the heat-rays of the spectrum, for these are practically transmitted by iodine, and cut off by alum.

The indigo-rays were next brought into position. The spot of light moved 3 divisions on the graduated scale. Alum cut off only a very little of the action; but the iodine cell was completely opaque to the rays, and brought the index to zero.

Finally, the invisible ultra-violet rays of the spectrum were brought into position. The train being of quartz these were abundant. Care was taken to keep any of the

luminous rays away from the pith disk. I think I succeeded in this; but it was not easy, owing to the fluorescence of the card and other surfaces on which stray rays fell. The spot of light moved 2 divisions, which were increased to 5 when the invisible rays were further concentrated by a quartz lens. The interposition of the iodine cell cut off the whole of the action. The alum plate cut off about half of the action, but scarcely more than would have been cut off had a piece of colourless glass of the same thickness been interposed, and it must be remembered that the alum plate has glass and Canada balsam on each side.

111. A similar experiment with the solar spectrum gave the following deflections, glass prisms being used:—

Ultra-red	2
Extreme red	6
Orange	5
Green.. .. .	4.5
Indigo	3.5
Ultra-violet	2

Although I give the number of divisions shown by the luminous index, I attach little importance to them as quantitative measurements. They are only single observations, and were taken before I had succeeded in getting anything like the same sensitiveness I can now attain in the apparatus. As illustrations of the fact, however, that the more refrangible rays of the spectrum act as well as the lower rays, they may be taken as trustworthy.*

112. In my former paper on this subject I have already mentioned in detail that at a certain point of rarefaction there is neither attraction nor repulsion when radiation falls on the movable index (30, 43, 47, 66). I have long tried to ascertain the law governing the position of this neutral point. My results are not yet ready for publication; but they are shaping themselves in order, and will, I trust, lead to a true explanation of the cause of these phenomena.

The barometric position of the neutral point dividing attraction from repulsion varies according to circumstances; among these may be mentioned the density of the substance on which radiation falls, the ratio of its mass to its surface, its radiating- and conducting-power for heat, the physical condition of its surface, the kind of gas filling the apparatus, the intensity of radiation, and the temperature of the surrounding atmosphere.

When the surface exposed to radiation is pith, the neutral point is somewhat low. I have had it vary between 50 millims. and 7 millims. (30) below a vacuum. It is, however, impossible to ascertain exactly; for a point of rarefaction can be obtained at which the warm fingers repel, and incandescent platinum attracts. With a heavy metal in the form of a sphere, so as to expose the smallest surface in proportion to the mass, I have not attained the neutral point until the exhaustion was within a very small fraction of a millimetre (43, 47); whilst if the metal is in the form of thin foil the neutral point may easily be got lower than with pith.

I am inclined to believe that the true action of radiation is repulsion at any pressure, and that the attraction observed when the rarefaction is below the neutral point is caused by some modifying circumstance connected with the surrounding gas, not necessarily of the nature of air-currents (80). As a proof of this I have not unfrequently obtained repulsion from radiation when the apparatus was full of air at the normal pressure.

113. The following experiments are too few in number, and have not been varied sufficiently as to conditions, to enable many inferences to be drawn from them. However, they afford glimpses of a law governing the position of the neutral point.

A torsion-apparatus was fitted up similar to the one

* A Paper communicated to the Royal Society, March 20, 1875. From the *Philosophical Transactions of the Royal Society of London*, vol. clxv, pt. 2.

* Everything is ready to try a series of experiments with the solar spectrum, as soon as sunshine is available. The results shall be communicated in a subsequent paper.

described in paragraph 102. The beam was of glass, and at one extremity was fitted with a spring clip, also of glass, so that different bodies could be experimented with. Disks of platinum foil, 1 centimetre in diameter and weighing 1.28 grs. each, were prepared, and they were fixed in the clip at the end of the torsion beam, either singly or two, three, or four together, in such a manner that while the disk exposed was always 1 centim. in diameter, the weights should be in the proportion 1, 2, 3, 4. At the other end of the beam a movable counterpoise was arranged, so that the length of beam from the platinum disk to the centre was always the same.

The neutral points were as follows:—

No. of Disks.	Barometer.	Gauge.	Dif. = Neutral point.	Differences.
1.	760	682	78	
2.	760	690	70	8
	760	706	54	16
	760	730	30	24

114. Two pieces of platinum, *a* and *b*, were now cut from the same sheet, each having 1 square centim. of surface. *a* was left the full size, but *b* was carefully folded in four, so as to expose a surface of only $\frac{1}{4}$ of a square centimetre, the weight remaining the same. The neutral points were then taken. The average of several observations (which, however, were not quite so concordant as could have been wished) were, below a vacuum,

<i>a</i> .	<i>b</i> .
136 millims.	70 millims.

The pieces of foil were then coated with lampblack, and observations again taken. This time the neutral points came out—

<i>a</i> .	<i>b</i> .
66 millims.	124 millims.

An intimate connection is thus shown to exist between the absorbing (and radiating) power of the surface on which radiation falls and the atmospheric tension at which the movement is reduced to a minimum. Further experiments on this subject are in progress.

(To be continued.)

NOTE ON ATACAMITE.

By T. C. CLOUD, A.R.S.M.

THIS mineral is found in large quantities in this district, and some mines have produced magnificent specimens. In many cases it is evident that this mineral has been formed from the oxide most probably by the action of salt water. I have specimens in my possession consisting of a central portion of massive cuprite with crystals of the same, the whole being converted to a depth of about 0.1 inch into atacamite.

When this mineral occurs in contact with limestone rock near the surface of the country it is invariably converted more or less into green carbonate of copper; in some cases this change has only extended to a slight depth, while in others the whole mass is thus converted.

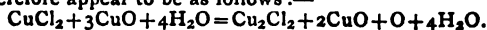
The following are the results of an analysis of a well crystallised specimen of atacamite from this district (Yorke's Peninsula).

Copper	13.73
Chlorine	15.38
Protoxide	55.91
Insoluble residue .. .	1.47
Water, by difference .. .	13.51
	100.00

The crystals selected for the analysis were about $\frac{1}{2}$ inch long, of a clear dark green colour, and perfectly transparent.

It was desired to ascertain the combined action of heat and air on oxychloride of copper. For this purpose a portion of the substance employed in the above analysis was placed in the centre of a combustion tube between two plugs of asbestos; air from a gas holder was passed slowly through the tube, while the latter was heated gradually up to the highest temperature obtainable with a charcoal combustion furnace. This temperature was maintained until the sublimate did not appear to increase further in quantity. When cold the contents of the tube were examined. At the cooler part of the tube a sublimate had formed varying in colour from light yellow to dark brown. On examination this proved to be subchloride of copper. In the place of the original substance there remained a brilliant black fritted mass of protoxide of copper. The internal portion of the tube extending for a short distance from the point where the original substance was placed, towards that part of the tube where the sublimate had formed, was converted into a bluish green glass. At the commencement of the experiment, when the temperature was comparatively very low, oxygen was evolved. I do not know whether this reaction has been noted before, but it is readily observed on heating a small portion of atacamite in a test-tube.

The experiment detailed above was repeated, the atacamite powder in this case being placed in a platinum boat, all the other conditions remaining the same; the results were identical with those obtained in the former experiment. The reaction which takes place when oxychloride of copper is heated with access of air would therefore appear to be as follows:—



Laboratory, Wallaroo Smelting Works,
Wallaroo, South Australia,
October 5, 1876.

BUTTER ANALYSIS. AN IMPROVED METHOD OF ASCERTAINING THE SPECIFIC GRAVITIES OF FATS.

By C. ESTCOURT, F.C.S.

Analyst to the City of Manchester, Borough of Oldham, &c.

THE great advance which has been made in food analysis since the passing of the "Food Adulteration Act of 1872" is nowhere so apparent as in the methods employed to detect adulterations in butter. It is scarcely three years since the time when the only methods of butter analysis, so-called, consisted entirely of smelling and tasting. Thus we had a butter taste, a tallow taste, and a lard taste. The first advance made was the observations of the fusing-points of different fats, and the next one was the estimation of the fatty acids present in fats of various origin. The last named process has, since its discovery by Messrs. Angell and Hehner, been so elaborated by various workers, amongst whom are Drs. Dupré and Muter, that nothing further in this direction can be expected.

The process, however, which recommends itself by its simplicity, and its good results, if properly carried out, is that of taking the specific gravities of various fats, butter fat amongst others. This process, devised by Mr. James Bell, F.C.S., principal of the Inland Revenue Laboratory, has only been slightly modified since its first application. The modifications were the change of temperature in the water used to compare with the fat, and the use of specific gravity beads.

In ascertaining the presence of, and estimating the quantity of foreign fat in butter by either the fatty acid, or the ordinary specific gravity method, several difficulties present themselves. In the first

method the possible loss in manipulation, and the tedious nature of the process (shortened as it has been) are strong objections. In the second method no objection can be made as to the time occupied, but a serious consideration is the extreme care necessary in taking gravities at so high a temperature as 100° F. by means of a specific gravity bottle. Those who have tried a large number of these determinations will see how difficult it is to be certain that the gravity bottle is filled with the fat and cleared of all outside deposits exactly at 100 F. A degree, more or less, is quite equal to 0.5 in the gravity, and this difference will certainly occur where two operators are examining the same sample, and sometimes in two experiments by the same operator.

Having tried all these methods with fair success I was led, by the considerations I have stated, to try whether the specific gravity of fats could be taken by means of a specific gravity balance, working by immersion, the tube containing the fats being kept at a constant temperature. Naturally my first idea was the water or steam bath, and I may say at once that no objection can be taken to it on the ground of high temperature, as the first step in all processes for butter analysis is to heat it on the bath until the curd and water deposit.

I found, however, that the steam constantly deposited on the beam of the balance, and thus affected the results. I therefore devised a method free from this inconvenience, and which I have found to give exceedingly constant results.

The balance I use is one made by G. Westphal, of Celle, Hanover, and works very accurately. The bulb of this balance is suspended in the test-tube (1½ in. by 5) which contains the fat. This test-tube is immersed in a metal tube containing paraffin (any other substance with high boiling-point will do), which is closed at the bottom. This tube is fastened securely by luting, &c., on to the lid of a small water-bath of suitable size, which has an outlet for steam, to which a glass tube can be attached, and a tube at the side to indicate the quantity of water in the bath.

The *modus operandi* is as follows:—The water-bath is fitted up to the proper height, which should be always the same. The metal tube is filled with paraffin, and when (heat having been applied) the paraffin is melted a thermometer is placed on it and the test-tube of fat. When the fat is melted the balance is adjusted, the bulb is immersed in the fat, and the weights (approximate) are placed on the beam. When the temperature of the paraffin indicates 206° F. I exactly adjust the weights, and then when it becomes stationary for a minute, which it does in my bath at 208° F., I put the exact weights on, allow it to remain in equilibrium for five minutes, then record the weight, which is the specific gravity of the fat under examination.

I give below the results of a series of experiments with this apparatus.

No.	Description of Fat.	Temperature of Paraffin Bath 205° F.	
		Specific Gravities.	
		Found.	Calculated.
1.	Beef fat	860.0	—
2.	Mutton fat	860.6	—
3.	Lard home rendered..	862.8	—
4.	Butter M.	870.0	—
5.	Butter BB... .. .	870.7	—
6.	Equal weights of Mutton No. 2 and butter BB. . .	865.6	865.0
7.	Equal weights of beef No. 1 and butter M.	865.7	865.8
8.	Equal weights of lard No. 3 and butter M.	865.8	866.4
9.	Dutch butterine.. ..	865.2	—

In performing the above experiments I have alternately heated and cooled the fats and found the specific gravities fairly constant. It is not the least recommendation of

this method that a dozen observers will (unlike in the fatty acid and the gravity bottle method) arrive at the same results. It will be observed that the ordinary way of calculating the amount of foreign fats is rather in favour of the vendor of the adulterated article, as equal weights of fats mixed do not produce exactly average gravities, as at first sight might have been supposed. In conclusion I may point out that each observer should test his balance and apparatus with the various fats, as the stationary temperature of his own apparatus may slightly vary from 208 F.

NEW METHOD OF SEPARATING NICKEL AND COBALT.

By ANTHONY GUYARD (HUGO TAMM).

THE alkaline sulphocyanides exert an unequal action on the sulphides of nickel and of cobalt recently precipitated. In the cold we do not observe a very marked action, but on raising the temperature we see the sulphide of nickel enter into solution with a very great facility, whilst the sulphide of cobalt resists more, and only dissolves even in a considerable excess of sulphocyanide, after prolonged boiling. This reaction is not sufficiently distinct for analytical application, but by a modification we render it practical, and find ourselves in possession of a very elegant and very exact method of separating nickel from cobalt. In fact, in cold and very dilute liquids, the sulphide of nickel recently precipitated is dissolved with a surprising rapidity in cyanide of potassium, whilst sulphide of cobalt is perfectly insoluble. In these conditions the reaction is so clear and distinct that we may find in the oxide of nickel traces of cobalt (which we could only detect by the aid of the blowpipe), and effect their separation.

In the course of an analysis the best way of proceeding is as follows:—We separate, in the usual manner, the cobalt and nickel from the metals which accompany them; then we precipitate both by a slight excess of sulphide of ammonium. We dilute the liquid with a suitable quantity of water; then add gradually a weak solution of cyanide of potassium, avoiding excess. This operation is rendered easy by the fact that the mass of sulphides clears up, and the sulphide of cobalt floats in particles detached from each other, and we distinctly see what passes in the liquid. We then filter, collect the sulphide of cobalt, and determine the cobalt in the ordinary way. To isolate the nickel we acidulate the filtered liquid with a slight excess of muriatic or sulphuric acid. The nickel is precipitated in the state of cyanide, and that so completely that we cannot find traces of it in the liquid. This cyanide is collected upon a filter, well washed, then calcined. Oxide of nickel is thus obtained so pure, in some cases, that it may be weighed and determined at once as nickel. However, in general, it is prudent to purify this oxide, which often retains silica: in this case we proceed in the ordinary manner.

The advantage of the process which I propose for the separation of nickel and cobalt is that it permits us to determine the nickel without having to manipulate it in the state of sulphide—an operation always long, very delicate, and very troublesome.

Under favourable circumstances the analytic process that I have just explained will certainly be one of the most simple processes, and may be applied to the separation of nickel and cobalt on a large scale.—*Bulletin de la Société Chimique de Paris.*

Project of a Great Aquarium.—At the Exhibition to be held at Paris, in 1878, M. Toselli proposes to construct a great aquarium to serve for the display of diving-bells, instruments for raising sunken ships and their cargoes, &c.—*Les Mondes.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 7th, 1876.

Dr. J. H. GLADSTONE, F.R.S., Vice-President, in the Chair.

AFTER the names of the visitors had been announced, and the minutes of the previous meeting read and confirmed, the following names were read for the first time:—Messrs. W. Hampton, J. Napier, D. W. Ladley, J. C. Leach, and W. H. Ellis. Messrs. Walter Charles Davis, John Clark, Frank Herbert Marshall, John Wood, Griffith Jones, B.A., John Falconer King, and Charles Cecil Capel were elected Fellows of the Society by ballot, after their names had been read for the third time.

The first communication was by Prof. A. H. CHURCH, "On Colein." This, the red colouring matter existing in the stems and leaves of the *Coleus Verschaffellii*, was prepared from the bruised stems by exhausting them with cold alcohol, slightly acidulated with sulphuric acid, removing the acid by barium carbonate, and concentrating by distillation. The various processes were tried for the purification of the red colouring matter, the best being to dissolve it in alcohol, precipitate with ether, again dissolve in alcohol, and pour the solution into water, repeatedly washing the precipitate with water at 50° to 60° C. On analysis it gave numbers corresponding with the formula $C_{10}H_{10}O_5$: this was confirmed by the results obtained from the lead compound, $C_{20}H_{18}PbO_{10}$. The latter was prepared by precipitating the colein with excess of lead acetate, both in alcoholic solution. It is of a dull indigo-blue colour. Colein is insoluble in ether, only slightly soluble in water, but readily in alcohol, yielding a solution, which is at first crimson, but fades rapidly, owing to a combination taking place between the alcohol and the colouring matter. On evaporating the nearly colourless solution, or on adding an acid, the crimson colour is, however, restored. By gradually adding ammonia to a solution of colein, the colour is changed successively to purple, violet, indigo, chrome green, and finally to greyish yellow. Stannic chloride gives a precipitate of a beautiful violet colour when added to a strong alcoholic solution of colein. The author also described and exhibited the spectra of colein, both in a pure state, and also when submitted to the action of various reagents.

The CHAIRMAN having thanked Prof. Church for his interesting paper,

A MEMBER said that when working with ivy he had extracted a colouring matter from the pericarp of the fruit, which appeared to be analogous, if not identical, with the colein of Prof. Church. Its colour was intensified by the addition of acids, whilst alkalies, on the contrary, changed it.

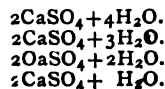
Mr. GROSJEAN, in reference to the author's remark as to the close resemblance between the colouring matter of the grape and colein, stated that when determining the value of red argols he had noticed that the colouring matter present gave a very sharp reaction with alkalies, almost as distinct in fact as litmus. In this case, however, the yellowish tint produced by a slight excess of soda was again changed to red on the addition of an acid, whilst colein appears to be decomposed, as the colour, when once changed by an alkali, does not come back.

Dr. OTTO WITT made a short verbal communication "On Phenylen-Diamin." This was prepared by the action of reducing agents on dinitrobenzene, and is employed in the manufacture of the brown dye known as "Vesuvine." It may be obtained from the solution as a crystalline hydrochloride, after the removal of the lime by oxalic acid. On distilling the hydrochloride with lime, the phenylen-diamin passes over. It is a colourless crystalline substance, which, however, rapidly becomes dark

coloured on exposure to the air. The author has obtained the diacetyl compound, and also several brominated derivatives of the latter. He hoped soon to lay before the Society a detailed account of the manner of preparation and the properties of these compounds.

Dr. GLADSTONE having thanked the author in the name of the Fellows,

The SECRETARY read a paper by Mr. J. B. HANNAY, "On Calcium Sulphate." The paper contains a description of various double and triple salts containing $CaSO_4$, which were deposited in the interior of pipes in a manufactory. Solutions circulated through these pipes containing simultaneously K_2SO_4 , Na_2SO_4 , $CaSO_4$, $MgSO_4$, and K_2CrO_4 , the last being in by far the largest proportion. The temperature of the liquids varied from 40° to 80° C. In one instance most of the incrustation consisted of $CaK_2(SO_4)_2 + H_2O$, but there were also present two other compounds, $CaSO_4.K_2CrO_4 + H_2O$ and $CaSO_4.2K_2CrO_4$. They were both of a bright golden colour, resembling lead iodide, and very similar in appearance. By the action of water they are decomposed, the potassium chromate dissolving out, and leaving calcium sulphate, but without any change in the form of the crystal. In another pipe, where there were large quantities of the salt $CaNa_2(SO_4)_2$, a salt having the formula $CaSO_4.Na_2SO_4.K_2CrO_4 + H_2O$, or some multiple of this, was found. The author has also made several experiments to ascertain if the following series of compounds existed:—



The first of these is deposited when a solution of calcium sulphate is evaporated at 100° C. under the ordinary pressure, and the last by evaporation under a pressure of 90 pounds to the square inch. No definite results could be obtained at intermediate pressures. On heating $CaSO_4 + 4H_2O$ (pure selenite) to 118° it begins to lose water, at 150° the loss indicated the formation of $2CaSO_4 + H_2O$. At 190° the last molecule of water is driven off. By heating the selenite first at 118° to start the dissociation, and then at 100° for a long time, indications were obtained of the existence of $2CaSO_4 + 3H_2O$, but none of the compound $2CaSO_4 + 2H_2O$.

Dr. H. E. ARMSTRONG said he had made some experiments with a view to ascertain if there was any relation between the loss of water experienced by certain isomorphous salts under precisely similar circumstances. He had found that at the ordinary temperature over sulphuric acid the sulphates of zinc, magnesium, nickel, and iron parted with their water of crystallisation in ratios represented by the numbers—Zn, 7460; Mg, 2685; Ni, 1570; and Fe, 4015. With potash and chrome alums the ratios were—K 0865, and C 4625; the nitrates of cobalt, nickel, and manganese gave—Co, 272; Ni, 032; and Mn, 210.

The CHAIRMAN having thanked the author for his paper, and Dr. Armstrong for his interesting observations,

Mr. G. S. JOHNSON read some "Additional Notes on Potassium Tri-iodide," consisting of a corrected determination of the specific gravity of the crystals, which was found to be 3.498, and the atomic volume, which is 120.2. The theoretical number, calculated on the supposition that an atom of potassium unites with three of iodine without condensation, is 122.2.

The meeting was then adjourned until Thursday, December 21, when Mr. W. N. Hartley will give a paper entitled "A Further Study of Fluid Cavities."

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.
General Meeting, October 26th, 1876.

The PRESIDENT in the Chair.

The minutes of the last meeting were read and confirmed.

The following Report of the Committee was read:—

In commencing the ninth session of the Society the Committee find that there is but little on which they need specially remark.

The number of members remains about the same, in spite of additions to the list of new names, these being about balanced by withdrawals and removals from the district. The Committee would here observe that considerable trouble is caused by gentlemen who, without giving any formal notice of withdrawal, neglect to pay their subscriptions, and take no notice of the applications of the Treasurer. As every member, so long as his name remains on the list, causes to the Society a certain amount of trouble and expense, the Committee feel that it would be only fair on the part of these members to signify to the Secretaries their desire to withdraw.

The deficit, irrespective of arrears of subscriptions, has increased during the last twelve months, and the Committee will probably have to consider two alternatives—a less extended report of the discussions upon papers, or an abandonment of the refreshments which have been for some sessions provided at ordinary meetings; unless, indeed, some source of increased revenue can be suggested, e.g., an increased list of members.

The Committee are, of course, hardly in a position at present to express a decided opinion on this very important point, but they hope to bring it before an early general meeting.

In conclusion, the Committee appeal to all members to assist them in their efforts to render the ensuing session a successful one, by personal co-operation. It will be seen, by referring to the *Transactions*, that the bulk of the labour in this respect has been borne by members whose names recur but too frequently, and the Committee would earnestly impress the desirability of a change in this respect.

Mr. N. H. Martin was unanimously elected a member.

The following names were read for the first time:—John Henry Payne, Jarrow; William Crake, Newcastle; H. E. Scholefield, Newcastle.

PRESIDENT'S ADDRESS.

GENTLEMEN,—Before commencing the Address, the delivery of which custom imposes upon me, permit me to thank you very sincerely for the honour you have done me in electing me as your President—an honour which I appreciate none the less that I could most sincerely have wished it had fallen upon some other member of the Society. One of the principal difficulties which a President must experience on such an occasion lies in the selection of topics; not but that in the range of our science there is an abundance on which to speak, to more or less profitable purpose, but the difficulty is really to select amongst the mass of materials which present themselves at the very outset. We enter to-night upon our ninth session. I may assume then, I think, that our *raison d'être* is abundantly demonstrated, and it is hardly necessary that I should occupy your time in considering what are the functions of a Society like our own, and how far we discharge them. When we turn to the other alternative, a more or less systematic review of the progress of our science during the last twelve months, we experience at once the difficulty of selection. The *Journal of the Chemical Society*, as most of you know, is made up almost entirely of abstracts, condensed of necessity into the very smallest space; and yet, during the six months ending last June, it occupied no less than 998 closely-printed pages. We may, however, select from among the varied subjects which have occupied our little world during the last twelve months some sufficiently prominent to afford materials for a few minutes consideration.

We have no particularly sensational—if I may permit myself the term—discovery to record. The nearest approach to that, perhaps, is the further examination by M. de Boisbaudran of his new metal Gallium; and here I may remind you of the reclamation made by M. Men-

deleef in connection with this subject, and with the theory which he promulgated more than seven years ago, that "the physical characters of a radicle are periodic functions of its atomic weight." Having pointed that out, he proceeds to remind us that the characteristics which are assigned to gallium are precisely those which he assigned seven years ago to the metal which he then designated "Ekaluminum," and which he argued, on purely mathematical grounds, ought to exist. Now, whether this is merely a more or less interesting coincidence, or whether it is really the climax of a process of pure mathematical reasoning, by which we shall be able to predicate radicles which *ought* to exist, we can hardly yet say. When "Ekasilicium," of which he has also predicted upon purely mathematical grounds the existence, is discovered, and discovered existing, as he says it will exist, in company with arsenic, we shall then, I think, have a rather wider basis for induction. Still we must admit that the coincidence, if a coincidence it be, is a very interesting one, and one well worthy of being recorded. Passing from this to a closely-allied subject, I may remind you of the interesting paper, produced in the course of last year by Prof. Henry Wurtz, on, as he entitles it, "A New System of Geometrical Chemistry." If you have read that paper I am sure you will agree with me that the greatest credit is due to him for the untiring labour which must have gone to the collecting of the data for his system. Every specific gravity which has ever been published on reliable authority for any compound appears to have been collated by him; and in a not less notable manner is his ingenuity displayed in putting together these data, and in inducing eventually three laws, which I should certainly advise you to read for yourselves.

Passing from the applications of the purer and higher—for I suppose we must say the higher—science of mathematics to our experimental data, we come to one or two subjects upon which purely experimental data, and data of very considerable value, have been afforded to us during the past year. Mr. Thomas has produced two papers—or I should rather more correctly say three—of the very highest interest, on the "Gases Occluded by Coal." I will not detain you by going into details which you can read for yourselves in the *Journal of the Chemical Society*, but I cannot help remarking that they are of exceeding interest, as additions to our knowledge on the subject, of which we knew little or nothing previously, with the exception of the somewhat imperfect researches of Von Meyer,—researches imperfect, not because there had not been every care bestowed upon them, but imperfect, as I cannot but think, from the method employed in carrying them out. I may remind you of his process for collecting these occluded gases, consisting in heating a flask filled, partly with the coal under examination, partly with recently boiled water, and collecting the gases evolved also over water. I need scarcely point out to anyone who has even a limited experience of gas analysis the imperfections of this method, in regard both to evolution and collection of the gases. The more perfect method employed by Mr. Thomas, of heating in a vacuum produced by the use of a Sprengel pump, has yielded results very different from those of Von Meyer, and which, when the series of researches is completed, cannot but be of the greatest value to all who are concerned with the technical as well as theoretical consideration of the subject.

Mr. Galloway has dealt with a kindred subject—"The Effect of Coal-Dust upon the Productions of Explosions in Coal-Mines." Many of us, I believe, were present at the exceedingly interesting demonstrations which Mr. Galloway gave, some two or three years ago, in this room, in connection with his former research upon the effect of a sound-wave on the passage of flame. This latter subject, which Mr. Galloway has investigated, is equally closely connected with the well-being of coal-pits, and I may therefore state briefly the results at which he has arrived. It might have been very well doubted—and it is, in fact, even now to a certain extent doubtful—how far

dust *per se* is capable of producing, when unmixed with fire-damp, a mixture with air which can be termed explosive in the ordinary sense of the term. Experiments are in progress with the view of determining this point, and it is not impossible we may be able to lay some of the results before our Society during the present session. But what Mr. Galloway has shown us is, that where, in addition to coal-dust, there is present a very small proportion of damp, which can hardly show itself by a cap on the miners' safety lamp, that very small quantity is equal to the formation of an explosive mixture. A quantity, ranging from 1 to 2 per cent of fire-damp, when mixed thoroughly with the air of the mine and coal-dust, and passing over a naked light, is capable of producing an explosion, or, on a small scale, an exceedingly rapid combustion. Clearly these experiments bear upon the everyday work of our own district, and, as such, we are indebted to Mr. Galloway for his painstaking investigation of an exceedingly important question.

I come now to a set of experiments which possibly many of you have already read in detail, and which partake alike of the purely scientific and of the practically interesting character. I allude to the researches which Dr. Tyndall has conducted, after his well-known patient method of experiment, on the relation of the optical deportment of the atmosphere to the phenomena of putrefaction and fermentation. It is so obviously impossible to give more than the very briefest abbreviation of these results that I must refer you for details to the paper in the *Transactions of the Royal Society*; but the cardinal experiment, of which all the others are variations, and upon which the proof of Prof. Tyndall's proposition mainly rests, I think I shall be able to explain in a very few minutes, with the assistance of the working model on the table. I need not remind you, I suppose, of the former researches of Prof. Tyndall in this same direction. I need not point out to you how he has shown that the purity or otherwise, as regards suspended matter, of the atmosphere can be determined rapidly, easily, and certainly, with the assistance of a sufficiently powerful beam of light. I need not remind you of the "motes in the sunbeam," which Prof. Tyndall has happily adopted as the term to designate the somewhat indefinite suspended matter of the atmosphere, but I may just illustrate by experiment his beautiful demonstration of the probability of the organic character of—at any rate by far the larger portion of—that suspended matter. If we turn on this lime-light, and bring below its track, marked out in the air of the darkened room, a Bunsen burner, you see the appearance of smoke produced by the heated air traversing the light track, and destroying the suspended matter. Now, extending the application of this process, Prof. Tyndall has constructed an apparatus, of which we have a rough working model before us on the table. We have a box which can be closed practically dust-tight. We have the means of transmitting a powerful beam, such as we have just been using, from side to side of the box, and so observing whether there is any difference in optical deportment of the air inside the box and the air outside it. We have, of course, in front the means of observing this; and we have a small door fastened dust-tight, by which we can keep the box in communication with the external atmosphere, or not, at will. Lastly, we have an aperture above through which we can pass the point of a pipette. We varnish the sides, top, and bottom of the box with a mixture of glycerin and water, to act as a mote trap and detain the suspended matter which settles upon it. Then, closing the different apertures of the box, we leave it to itself for a few days, and from time to time examine it with the help of such a beam (or a stronger one), as you have just seen. After a time the whole of the motes in the little portion of included air have settled on the sides and bottom of the box. The track of the beam of light can no longer be distinguished inside the box, although we can see it easily before it enters and after it emerges; and now our air is optically pure, and in a condition to com-

mence experimenting with. Then, passing through the pin-hole the pipette, we fill by its means the test-tubes which you see are cemented into the bottom of the box with an infusion of any animal or vegetable matter you choose. We abandon these, after heating them to rather above boiling-point by a salt-bath below, to their own devices. Now, Dr. Tyndall has repeated this experiment with some 600 different test-tubes containing every variety of infusion, and he has found that when the tubes have been heated to boiling in contact with the mote-free air, and then abandoned to themselves, they have never in any one case undergone the action which we style putrefaction, and after they have remained for some time unputrefied the mere opening of the box is sufficient in two or three days, by the action of the motes in the air from outside, to initiate with unerring certainty the phenomenon of putrefaction. I cannot see how we can logically come to any other conclusion than that this phenomenon, and, probably, its close ally fermentation, depend upon the action of what Prof. Tyndall calls motes. Others perhaps would give to them the name of germs, but if we call them motes we commit ourselves to nothing except that the suspended matter of the atmosphere is closely connected with these phenomena. I should weary you if I were to go into detail on the different forms in which this experiment has been repeated. You will find them described at length in the original paper, and the more you read the more I think you will be possessed with a sense of their beauty. But there is one part of the experiments which is so exceedingly interesting, both theoretically and practically, that I must attempt its description. Let another set of tubes be connected with the sides of this box; let them be filled with a putrescible fluid; let that undergo the action of putrefaction; and when that action is at its highest, and when the gases evolved during it have completely filled the box, let the lower tubes be also filled with a putrescible fluid, by means of the pipette. Let that be boiled and abandoned to the action of the gases evolved during putrefaction, and in no case will it undergo putrefaction. It may be in the fullest contact with the most nauseous gases from putrefaction, but as long as only gases are brought into contact with it, it will not putrefy; but let the smallest fraction of matter already putrefying be introduced into the "protected" fluid, as we may term it, and putrefaction is absolutely certain. I should probably spend too much time if I were to go into details as to the practical bearings of this experiment, but I think you will see the analogy which Prof. Tyndall points out between this and the not unfrequent case of sewer gas causing zymotic disease is not a far-strained analogy after all. When we endeavour to trace a connection between sewer gas and zymotic disease we are constantly met with this objection—"If it is really the dreadful thing it is said to be, why is there not disease in every house in which it may be smelt?" Not to dwell on the probable necessity for a favourable *nidus* as well as for the germ, in order to initiate that class of disease, I may point out that here the sewer gas, instead of being actually the cause of disease, simply tells us, by its unmistakable smell, that communication is established between the drain and the house,—it may be to bring in only comparatively innocuous gas, but it may be to bring in a current of gas laden with zymotic poison, which we may liken to the motes in this box. And the more you consider this case the more you will see the close bearing this experiment of Prof. Tyndall's has upon a matter which concerns our public health in the closest degree.

I should not leave this subject, or, if I did, I should leave it exceedingly incomplete, if I did not refer to Dr. Frankland's elaborate paper on the examination of potable waters. I will not detain you by enlarging upon the vexed question of water analysis, but there are one or two points in the paper which are of sufficient interest to be worth remarking on. Probably many of you have read all that is there said of the case reported from Switzerland, of the conveyance of typhoid fever for very nearly a mile in dis-

tance through a water-supply. The two experiments cited are so interesting and so ingenious, and lead to such exceedingly important practical results, that I may go into them a little in detail. In the first instance, to establish the fact that the source of the water-supply from which the contagion was supposed to have been derived in the first instance was really in connection with the public wells, which were supposed to have conveyed the disease, the following experiment was made:—Some hundred-weights of common salt were put into the suspected water-supply, and in the course of a comparatively short time the quantity rose in the *well water* to sixteen or eighteen times the normal amount. I do not think we need any further proof that the two sources of water-supply were in complete connection; but to supplement that experiment, and to trace the effect of the filtration of the water through a very considerable length of porous soil, a few hundredweights of flour, sufficient to make the water thoroughly turbid, were thrown in and stirred into the suspected source. Although the salt had traversed the connecting strata not a trace of the flour could be detected, either by chemical or microscopic examination in the contaminated well water. Mechanical filtration then had been quite sufficient to remove this suspended matter, but had, nevertheless, been insufficient to remove the subtle typhoid infection. Now, that that proves positively that infection is due to a "germ," I do not say: it will be evident that the phenomenon is equally easily explicable, whether we suppose it to be due to an infinitesimal germ, so minute as to pass the filtering-bed in such way as an infinitesimal particle—say of sulphate of barium—passes a filter-paper; or whether we suppose it to be due to a definite soluble poison existing in solution; and therefore capable of passing any filter, no matter how effective. On either ground the results seem equally explicable; but they point clearly to one fact—that no process of mechanical filtration, however complete, can really be trusted to purify water which has once received the infection of the diseases which we group together for convenience under the name of zymotic.

(To be continued.)

NOTICES OF BOOKS.

Science in Sport made Philosophy in Earnest, being an Attempt to Illustrate some Elementary Principles of Physical Knowledge by means of Toys and Pastimes. Edited by ROBERT ROUTLEDGE, B.Sc., F.C.S. London: G. Routledge and Sons.

THE author of this work tells us that his original design was merely to produce a new edition of a work written some half century ago, by a Dr. J. A. Paris, under the title "*Philosophy in Sport made Science in Earnest.*" He found it necessary, however, to re-write and extend the whole of the scientific matter in the book in order to bring it into harmony with the existing state of knowledge. For the story with which the instructive portion of the original work is interwoven he has found it desirable to "substitute a quite different, much slighter, less intricate, and perhaps more probable tale."

This work, therefore, is a story, or, if the reader will, a novel made the vehicle of physical instruction and interspersed with lectures, or, as they are now called, "conferences." The author expresses a hope that no one will find in the narrative in itself so much attraction as to "skip" the graver portions of the book. How far he is right in this respect, considering the truly canine appetite with which fiction is devoured by the public, may perhaps be doubtful. Were we an authority on such points we might question the *raison d'être* of Miss Ryland and her sister-gossips—characters not wholly new in literature even though they combine with their morbid love of scandal the new mania for "woman's rights." They are

introduced without necessity; they neither exert any influence on the progress of the story, nor are made to illustrate any physical principle, and they soon disappear, having merely served to add a few pages to the bulk of the book. The science of the book, after a careful examination, appears to us accurate, and it is certainly illustrated with no small felicity. Exception may, however, be taken to certain remarks on colours in the sixth chapter. Thus the author asserts that "the supposed effect of scarlet (dazzling the eye) is explicable by its comparative rarity in nature, and I doubt not but that if all the green and red changed places we should be as much attracted by green as we now are by red, and would attribute to it the same exciting effect; while the repose you speak of as belonging to green would seem to belong to the scarlet foliage to which our eyes would be so much accustomed."

We are at a loss to conjecture upon what facts this singular opinion can be based. Scarlet is, indeed, somewhat rare in nature, but in dye works it is as plentiful as is green, and the examination of pieces of scarlet cloth to ascertain whether they are correct to shade is found very fatiguing to the eyes. If scarlet or even magenta swatches are regarded for a long time, and fixedly, the eye becomes temporarily incapable of judging of their exact tone. The observed effects of light of different colours upon vegetable life clash also with Mr. Routledge's view.

The fifteenth chapter, in which the author treats of work and its measurement of energy, and explains the meaning of the foot-pound, may be advantageously read, not merely by children, but by many of mature age who entertain somewhat hazy notions on this subject.

We hope this volume may meet with such a reception as to induce the author to extend his plan and produce a companion volume dealing in a similar manner with some of the many scientific questions not here included.

The Combined Note Book and Lecture Notes for the Use of Chemical Students. By THOMAS ELTOFT, F.C.S. London: Simpkin, Marshall, and Co. Manchester: John Heywood.

THIS book contains a table of the elementary bodies, with their symbols and atomic weights. Then follow remarks on elements, symbols, compounds, and chemical formulæ; on the use of brackets; on oxides, anhydrides, and acids; on the atomicity of the elements; tables of sulphides and sulphites; on the formation of chlorides and bromides, iodides, fluorides, and cyanides; on the salts of dibasic acids; on the density of gases and the "crith."

Then follow a number of leaves arranged for taking lecture notes, with certain headings to be filled up.

The last part of the book, as the author tells us, "contains all the best known methods for the preparation of the various elementary and compound substances," at least, as far as the non-metallic elements are concerned. He has "purposely left out any explanation as to the condition under which they are prepared, preferring that this should be done by the student himself, either from his lecture notes or text-books." By this method, it is said, he gains "two objects, viz., good and sound work without any cramming." Finally there is a table of tests for the most important acids.

The work, we are told, is "not in any way supposed to take the place of a text-book, but to act as an adjunct to it."

On the Present State of the Iron Manufacture in Sweden. By RICH. AKERMAN (School of Mines, Stockholm). London: E. and F. N. Spoon.

THE iron manufactures of Sweden, though long famous and still eminent as far as quality is concerned, are not carried on upon a scale of great magnitude. This is due to the want of coal, which is only found in the more southern part, and to the fact that the deposits of

iron-ore are remote from the more extensive forests and peat beds. The ores consist chiefly of magnetite and hæmatite. In some districts, such as Gräsberg, these two ores are so much mixed together that it is not easy to decide to which species samples ought to be assigned.

These ores belong to the primitive or Laurentian formation, and generally occur in stratified masses, having the same strike and dip as the surrounding rocks. They may be arranged in three classes, those rich in quartz, those abounding in magnesia, and those containing a notable amount of manganese and interspersed with sulphides. The latter class, when their proportion of sulphides is not considerable, have been highly valued for the preparation of steel. The amount of iron ranges from 30 to 70 per cent. They contain, in general, little phosphorus; those of Dannemora having only 0.003 per cent, and those of Persberg 0.05 per cent. The Grängesberg ores, however, have been known to contain even 1.5 per cent, being intermixed with apatite, whence it has been proposed to submit them to a preliminary treatment in the wet way utilising the apatite as superphosphate. Titanium, which is in some cases abundantly present, is an undesirable ingredient, as it renders the process of reduction more difficult and occasions a great waste of charcoal.

The total amount of ore raised in Sweden during the year 1874 from 696 mines was 21,692,998 centners, equal to 922,524,000 kilos. The number of persons employed was 7497. The book is illustrated with a large map of the mining districts of Southern Sweden, and contains a tabular view of the composition of Swedish iron-ores, inconveniently arranged. The continental method of using for decimals figures smaller than those denoting whole numbers has been followed, to the tribulation of the readers' eyes. The value of the work to practical men would also have been greater if the weights of metal, ore, &c., produced, exported, &c., had been calculated into tons instead of kilograms. Apart, however, from such mere defects of form and from certain expressions, which cannot be considered idiomatic English, this publication will be highly interesting to all persons connected with the iron manufacture.

OBITUARY.

DAVID FORBES, F.R.S.

THE saddest duty of the editor of a scientific journal is that of recording the death of eminent labourers in the field of science. In the too early death of David Forbes science has been deprived of one of her most zealous and hardworking devotees, while we have also to mourn the loss of a valued friend. Few men have enjoyed greater facilities for acquiring a knowledge of nature by personal observation in different parts of the world than David Forbes, and armed with dauntless courage and indomitable perseverance he made the most of his opportunities. Those who have heard him read papers at the Chemical or Geological Societies, or who have been present when he has taken part in a discussion know how thorough and how vast was his knowledge. It is to be hoped that the manuscript notes which he had made with the view of elaborating them in future years will not be entirely lost, but that they admit of being arranged and published in some form or other, though they would have been of infinitely higher value had they received the addition of those still larger stores of knowledge which are now entirely lost. In 1858 David Forbes was elected a Fellow of the Royal Society, and at the time of his death he was senior Secretary of the Geological Society and also foreign Secretary of the Iron and Steel Institute, a post for which he was eminently fitted. His reports on the iron and steel industries are most valuable additions to technical scientific literature. Many excellent papers

from his pen have appeared in the *CHEMICAL NEWS*; amongst them we may mention those entitled: "Application of the Blowpipe to the Quantitative Determination or Assay of Certain Metals;" "Some Points in Chemical Geology;" "The Preparation of Lime Crucibles for Great Heat;" "The Composition and Metallurgy of Some Norwegian Iron-Ores;" and "The Microscope in Geology."

He died at the age of 49, and was buried at Kensal Green Cemetery on Monday last. The Director General of the Geological Survey and the Presidents of the Chemical and Geological Societies were amongst those who were present at the grave.

The following account from the pen of Mr. F. Field, who was one of Forbes's intimate friends, renders it unnecessary for us to refer at greater length to the scientific results of his journeys and labours:—

"The death of David Forbes, a man at once chemist, geologist, and mining engineer, must have excited deep regret throughout the scientific world. Few men amongst us have travelled so much or have had the same opportunities of research. From Finland to the South of Spain in Europe, from Cape Horn to Panama in the western continent of South America, did his journeys extend, and his museum bears ample testimony to the energy and zeal with which they were prosecuted, embracing, as it does, rare and sometimes unique specimens, mostly collected by himself, of all branches of natural history from nearly every part of the globe. Only those who have travelled over the bad roads and mountainous districts of South America can appreciate the difficulty of transporting specimens from the interior of the country to the coast previously to their shipment for Europe. Perhaps a few reminiscences of David Forbes when a comparatively young man may not be altogether devoid of interest. I first met him in the Port of Coquimbo, Chile, in 1858, and was surprised at the rapidity with which he had acquired the Spanish language. He was a thorough cosmopolite, and seemed as much at home with the Chilean miners and smelters as if he had been born among them, entering into their peculiarities, accommodating himself to their mode of life, and making himself universally popular. Whilst most foreigners, Englishmen especially, on taking a journey to the various mines, require many comforts which they deem indispensable, and have, at times, almost a cavalcade of servants and mules, laden with provisions and bedding, Forbes, if the idea suddenly struck him, would take simply a single guide (and he often went quite unattended) and traversed the most distant portions of the Republic, with a rapidity and an amount of observation which were astonishing. Thus after being only a few weeks in Coquimbo, he had explored the Higuera, Tamaya, Arqueros, Andacollo, Ovalle, Tambidos, and nearly every other mineral district of importance, knowing them better than most foreigners who had resided in the country many years. I remember on one occasion he determined to make the journey from Coquimbo to Copiapó on horseback, taking with him but one servant and trusting for provisions on the way as best he might. The road is through a desert, where water is seldom obtainable, and should the horse founder far away from any habitation the consequences might be very serious. He seemed to think nothing of this or other contingencies, made the journey, and returned to Coquimbo a few weeks afterwards, fresher and better than ever. He had an iron frame, and in those days was perfectly insensible to fear. When he was staying with me some few months later, a gentleman fitted out a three-masted schooner, and purposed taking a long cruise to the Fijis and other islands in the South Pacific. Almost at a moment's notice Forbes offered to accompany him, and spent many months in that delightful part of the world. This may seem a trifling incident; it is only mentioned to show that while most of us take some time to consider, Forbes made up his mind instantly. In the Chile

Revolution of 1859 Forbes, with many other Englishmen, were my guests at the British Consulate. Although the revolutionary party were successful in the province of Coquimbo, the Government had the supremacy on the coast, and the port was strictly blockaded. The blockade was respected both by the English and French men-of-war. Forbes (I know not why) was determined to go to Bolivia. No person was allowed to leave the spot: the English steamer, on arrival, did not drop anchor, but moved slowly round the bay, depositing the mail-bag in the Chilian officers' boat. Forbes pleaded for a passage, but in vain. He was not the man, however, to be daunted by a refusal. He hired a small sailing-boat, and with only two men and a slender store of provisions left from a creek just outside the bay, by midnight, and made sail for Bolivia, leaving me the laconic lines—'Dear Field, I have broken their blockade.—D. F.' I subsequently learned from him that the winds had blown him many hundred miles beyond the port of Cobija, and he had to beat back against heavy seas for more than a week. He accomplished his purpose, but arrived, as may be supposed, half dead from fatigue and want of food.

"Although Forbes died at a comparatively early age, he had led in the half century the lives of at least three men. An intermittent fever he had contracted in Peru prostrated his strength greatly during the last few years of his life. I met him a month ago at the 'B.' Club, of which he was a member, and, although complaining of illness, he seemed to me more cheerful than he had been since his late heavy domestic affliction. I little thought when I wished him better that I had shaken hands with him for the last time.

"FREDERICK FIELD.

"Hither Green, Kent,
December 12, 1876."

CORRESPONDENCE.

SULPHUROUS ACID AS A DISINFECTANT.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 245) you reprint an article from the *Lancet* "On a Mode of Generating Sulphurous Acid for Use as a Disinfectant, &c.," by Mr. Keates, in which it is stated "that there is no ready, convenient, and easily controllable way of producing this valuable agent (sulphurous acid) in use at present;" and then Mr. Keates proceeds to describe a mode of generating the acid by the combustion of carbon disulphide, as if this method were a novelty.

I have used sulphurous acid generated exclusively from the combustion of carbon disulphide, as a disinfectant for rooms during a period of nearly seven years, and have in this way consumed 6 cwt. of the disulphide during the last six years. Years ago I advocated this mode of disinfection before the Society of Medical Officers of Health. I know that others besides myself have been in the habit of using it.

No special form of lamp is required. The requisite quantity of the disulphide may be placed in an ordinary porcelain or copper dish placed on a tripod, and ignited with a match. In five minutes several ounces of the liquid may be easily and safely burnt. A much larger quantity of the liquid should be used than that named by Mr. Keates—280 grs. for a room of 1300 cubic feet capacity. This would generate only 1-50th per cent by volume of sulphurous acid in the atmosphere of the room. At least five times that amount should be burnt, so as to generate an atmosphere containing 1-10th per cent of the disinfecting gas.—I am, &c.,

THOS. STEVENSON.

St. Pancras, Middlesex,
December 9, 1876.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 5, October 5, 1876.

Report on Cremation, delivered to the Prefect of Police by the "Council of Hygiene and Salubrity" of the Department of the Seine.—The Commission consider that cremation would be free from all objections on the score of public health, but that its economy would be doubtful except furnaces were maintained in continual action, and that by rendering the chemical examination of the body impossible it would prevent the detection of murder by poisoning.

Note on Herbelin's Method for the Expeditious Assay of Cinchona Barks.—M. Dubois.—The author finds that this method, which consists substantially in extracting the powdered bark with benzol after previous treatment with ammonia, does not give satisfactory results. Quinine is scarcely soluble in benzol, though the two compounds have a strong mutual affinity.

Phenomena of Digestion with the Cockroach.—The digestive juices of insects are alkaline or neutral, never acid.

New Experiments with the Radiometer.—D. S. Stroumbo.—If during the night a candle is lighted before a radiometer of the same height, and placed at the distance of 20 c.m., it turns from the right to the left of an observer, placed so that the radiometer is between him and the candle. The following facts were observed:—First. Whilst the radiometer continued to turn slowly from the right to the left I placed my five fingers on the glass stem of the instrument, and kept them there: in an instant the radiometer turned in the opposite direction, i.e., from the left to the right with a greater speed, and continued to turn thus indefinitely. When I removed my hand the radiometer slackened its speed, and after having turned so for some time it stopped for a few moments, and then resumed its ordinary course from right to left at a slow speed. Instead of applying five fingers I applied only one, but with the same result. I interposed silk, paper, and copper between the finger and the glass, but the same effect was produced, as also when I surrounded the glass foot of the instrument with a copper ring, which I held by a silk thread. I placed my finger on a point of the glass support very near the base at a distance of 10 to 13 c.m. from the circumference which the radiometer describes, when the same phenomenon took place, as also when I placed my finger on any point whatever, situated below the circle described by the radiometer. If I placed my finger at a point above this circle the instrument was not affected, and continued its ordinary course. If the finger is applied to the glass at a point of the circumference described by the radiometer, it stops after some oscillations, and remains at rest, but resumes its ordinary course as soon as the finger is removed. Second. The radiometer being at rest in a rather dark part of the room, I brought its glass foot in contact with a bow of copper, which I held by a strong piece of silk or cotton moistened, and which I drew horizontally. The radiometer began to turn. I let fall the bow, and the radiometer in a few moments ceased turning. I caused to be constructed a radiometer with plain discs of mica, which did not turn if placed in the sun. If it was not a radiometer, properly speaking, it was a sensitive instrument, with which the following experiments were made:—(1) I rubbed the glass surface of the instrument circularly from right to left with silk-paper; immediately the disks turned in the same direction, following the course of the paper. I rubbed in the opposite direction; immediately the disks changed their direction, still following that of the paper. The friction ceased, and the disks ceased simultaneously. The cause of this phenomenon is evident: the friction of the paper

develops electricity, which acts upon the disks by attraction in the direction of the electricity evolved. (2) This instrument being at rest, I poured upon it ether, and saw immediately the disks hover, turn slightly, and soon stop. The cause of this phenomenon is the same, the electricity produced by evaporation—a fact well known to science. (3) These facts (1 and 2) being incontestable, let us produce some analogous facts with the radiometer. (a) I placed the radiometer in a part of the room so dark that it did not turn. I then poured ether upon the covering, and immediately the radiometer began to turn somewhat quickly, but in a direction contrary to that which it takes when exposed to the light. After having turned thus for a few moments it stops, and resumes its former state of repose. According to the experiments 1 and 2 must not this fact be ascribed to electric action? (b) M. Ducretet has observed the change in the direction of the radiometer when drenched with ether; let us do the same. Whilst the radiometer is in motion, and turning from right to left, let us pour a little ether upon it; we then see the radiometer change its direction, and turn from left to right. After a few moments it stops, and finally resumes its normal course from right to left. Are we not to ascribe this change of direction to an electric action? The experiment of M. Govi, showing that the watery vapour circulating round the radiometer gives it an accelerated motion, which ceases in course of time, does it not show electricity in action? The new facts observed above (1, 2, and 3), should they not be attributed to electric action? Yet we are still very far from believing that the experiment has furnished us with sufficient data to arrive at a complete explanation of the phenomena of the radiometer. (4) We constructed a radiometer, in which three platinum wires, sealed into the glass covering, support each at its interior end a small copper disk. Two of the disks are vertical, but one (to the left of the author's diagram) is horizontal. With this instrument I experimented as follows:—I placed a lighted candle near this radiometer; it turned then from the left to the right. I put out the light, and when the radiometer was at rest I applied the current of a battery of 3 or 4 elements to a small Ruhmkorff coil. The ends of the fine wire of this coil were applied, the one to the exterior end of the platinum wire to the left, and the other to that at the right, the positive pole being connected with the left hand, when the radiometer turned in the same direction as above. If, whilst the radiometer was turning under the influence of the electric current, a lighted candle was brought near, the speed of the rotation increased considerably, a proof that the two actions took place in the same direction. We then placed the outer ends of the two platinum wires sealed in the glass in connection with a galvanometer whilst the radiometer was turning under the influence of a gas-jet. The needle of the galvanometer did not remain at rest, but described an angle of 5°. If the poles are inverted the radiometer stops. If the positive pole of the battery is brought near the exterior either of the base or the summit of the instrument it stops. The author expresses his intention of explaining these results in a future paper.

Scientific Information for Ladies!—In spite of all the efforts of the educational powers that be to spread scientific instruction amongst the people, the instances that daily crop up of the crass ignorance on matters of science, amongst even well-educated writers, are sufficiently amusing to the initiated. A wiseacre who has compiled the "Lady's Every-Day Book," describing castor oil, coolly informs us that "this very safe and common aperient is an oily substance secreted by the beaver. We obtain it both from Russia and America, but that obtained from the latter country is esteemed the best." We can fancy a fond mother trying to cram half an ounce of Russian castoreum, membranous bag and all, down her lovely infant's throat, under the impression that it was a "very safe aperient."

MEETINGS FOR THE WEEK.

- MONDAY, 18th.—Society of Arts, 8. (Cantor Lectures.) "The History of the Art of Coach Building," by Mr. G. A. Thrupp
Lecture V.—Rules of Coach building, and Theories applicable to the Carriages of the Future.
— Medical, 8.
— London Institution, 5.
TUESDAY, 19th.—Civil Engineers, 8. (Anniversary).
WEDNESDAY, 20th.—Society of Arts, 8. "The Centennial Exhibition, Philadelphia, 1876," by Prof. Archer.
— Geological, 8.
— Meteorological, 7.
THURSDAY, 21st.—Royal, 8.30.
— Chemical, 8.
— Philosophical Club, 6.30.
FRIDAY, 22nd.—Quekett Club, 8.

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E. Bevan.—Send us an account of the analysis when you have made it.

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THE CHEMICAL NEWS.

VOL. XXXIV. No. 891.

ON REPULSION RESULTING FROM RADIATION.—PART II.*

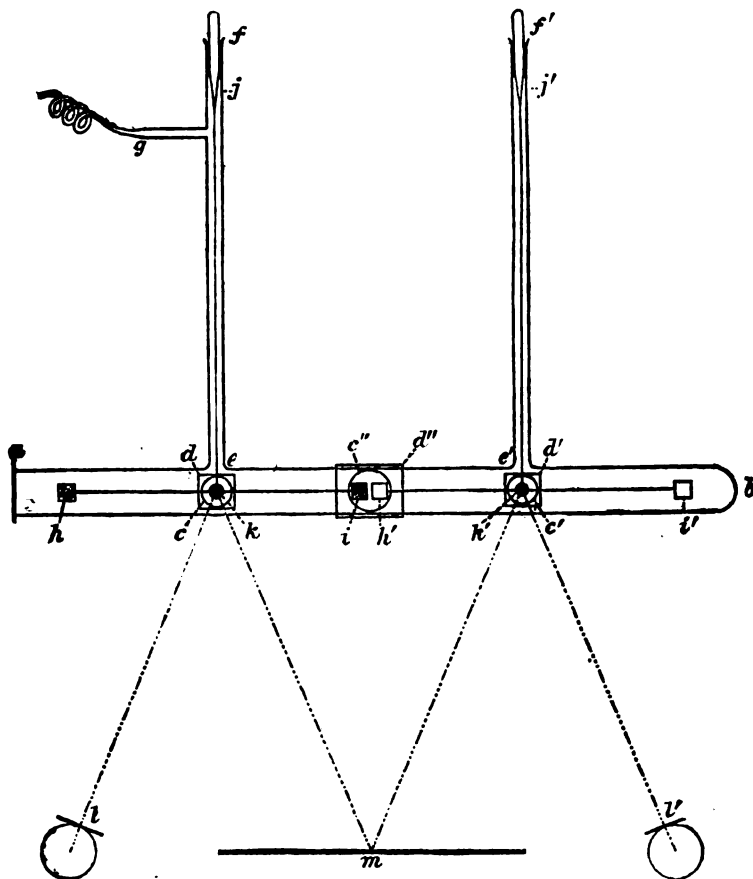
By WILLIAM CROOKES, F.R.S., &c.

(Concluded from p. 254).

115. It has already been said that when radiation falls on a thin surface of pith, the neutral point is low, whilst with a moderately thick piece of platinum it is generally high. I have constructed a double torsion apparatus by means of which these actions can be easily studied. Fig. 10 shows the arrangement of apparatus. It consists of a

ground perfectly flat. $a, c, c',$ and c'' can therefore be sealed up by cementing flat transparent plates of glass, quartz, rock-salt, &c., a, d, d', d'' on to them. At right angles to $a b$, and at the parts e, e' , upright tubes, f, f', f'', f''' , are sealed, one of them having an arm (g) blown into it for the purpose of attaching the apparatus to the pump. h, i, h', i' are glass beams made as light as possible consistent with the necessary stiffness. j, k, j', k' are glass fibres (103) cemented at j, j' to pieces of glass rod, and terminating at k, k' with a stirrup cut from aluminium foil, in which the glass beams h, i, h', i' rest. In front of these stirrups are thin glass mirrors (k, k'). At the ends of the beam (h, i) are cemented very thin pieces of blackened pith, each 1 centim. square; and at the ends of the other beam (h', i') are cemented pieces of platinum foil, also 1 centim. square. At l and l' are narrow slits, with lamps behind them, so arranged that they send their rays of light respectively on to the mirrors (k, k'), whence they are reflected back to the divided scale m . When the torsion beams are not acted on by any force, the rays of light both meet at zero (m), and there overlap, the

FIG. 10.



torsion apparatus constructed as the one shown in fig. 7 (102), with the exception of the arms being double. Similar parts in each drawing are shown by similar letters. $a b$ is a piece of thin glass tubing, sealed off at the end b , and ground perfectly flat at the end a . In the centre a circular hole (c'') is blown, and two others are blown at the parts c and c' ; the edges of these holes are also

slightest movement of either beam causing them to separate.

When the apparatus is full of air, a beam of radiation sufficiently wide to cover the whole window (c'') being thrown upon the plates i, h' , the latter are instantly attracted, as shown by the movement of the reflected rays of light ($k m, k' m$). On exhausting the tube, and trying the effect of a hot body at the central window from time to time, it is seen that the rays of light (i) gradually diminish in intensity.

* A Paper communicated to the Royal Society, March 20, 1875. From the *Philosophical Transactions of the Royal Society of London*, vol. clxv., pt. 2.

haustion (in this apparatus at about 50 millims. below a vacuum) the neutral point for pith is obtained. On increasing the rarefaction the pith is repelled by radiation, the platinum continuing to be attracted. On exhausting the air still further (to about 28 millims.) the neutral point for the platinum surface is obtained, higher rarefactions producing repulsion of each when radiation falls on the pith and platinum surfaces (*i*, *k'*).

At a rarefaction intermediate between the neutral point for pith (50 millims.) and the neutral point for platinum (28 millims.), the curious effect is produced of the same beam of radiation thrown into the window (*c''*) producing repulsion of the pith and attraction of the platinum, the two rays of light (*k m*, *k' m*) each moving to the right, and, if a piece of ice is presented to the central window, to the left. By adjusting the internal tension of the apparatus, a point may be reached (about 40 millims. below a vacuum) at which the repulsion of pith and the attraction of platinum are exactly equal, and then the two rays meeting at *m* do not separate, but together move to the right or left.

116. A series of experiments have been tried with a view to ascertain what influence the state of surface of the substance submitted to radiation has on the amount or the direction of its movement. A torsion apparatus was prepared similar to the one shown in fig. 7 (102), and having a thin disk of ivory at each end. One was coated with lampblack, whilst the other retained its white polished surface. The average of a number of experiments showed that, under the influence of the same source of radiation acting for the same time (15 seconds), the white ivory was repelled so as to send the luminous index 41.5 divisions of the scale, whilst the blackened ivory caused the index to move 46.8 divisions. These experiments were, however, tried in 1873,* when I had not succeeded in getting anything like the delicacy I now obtain in the apparatus; and I propose to repeat them under varied conditions before employing the results to found any arguments upon.

117. In my former paper on this subject (74, 75, 76, 77, 78) I have discussed various explanations which may be given of attraction and repulsion resulting from radiation; and in a lecture delivered before the Physical Society† I entered more fully into the same arguments. The most obvious explanation is that the movements are due to the currents formed in the residual gas, which, theoretically, must be present to some extent even in those vacua which are most nearly absolute.

Another possible explanation is that the movements are due to electricity developed on the moving body, or on the glass apparatus, by the incident radiation.

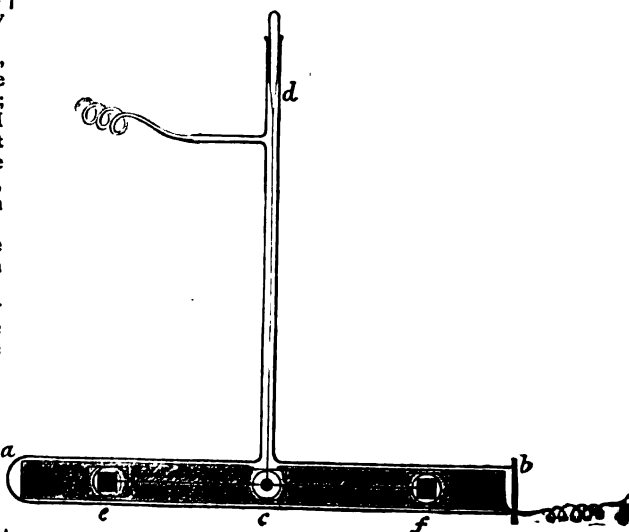
A third explanation has been put forward by Professor Osborne Reynolds, in a paper which was read before the Royal Society on June 18th, 1874. Referring to the results of my experiments, Prof. Reynolds says that it is the object of his paper to prove that these effects are the result of evaporation and condensation. In my exhausted tubes he assumes the presence of aqueous vapour, and then argues as follows:—"When the radiated heat from the lamp falls on the pith, its temperature will rise, and any moisture on it will begin to evaporate and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp; therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near, the temperature of the pith will be reduced, and it will condense the vapour and be drawn towards the ice."

It is not my intention to recapitulate the arguments I have already brought forward against these three explanations. They are all fully given in my above-quoted lecture before the Physical Society. I shall, however,

adduce a few experiments which have been devised specially with the view of putting one or other of these theories to the test. In giving what I conceive to be reasonable arguments against the explanations which have already been proposed, I do not, however, wish to insist upon any theory of my own to take their place. Any theory will account for some facts; but only the true explanation will satisfy all the conditions of the problem, and this cannot be said of either of the theories I have already discussed.

118. The pendulum apparatus, described and figured in paragraph 99, was specially devised to bear upon the air-current and the electrical theory. On referring to the description of the experiments tried with it (Tables I. and II.), it is seen that in air the ignited spiral produced attraction, whilst in a vacuum the same source of radiation gave strong repulsion. Now the effect of raising a platinum spiral to whiteness in the air would be to rarefy the air all round, and the suddenness of its ignition would cause the air to be driven from it, as a centre, on all sides. Hence I was prepared to find that the pendulum would be mechanically blown on one side by what might be likened to a miniature explosion of heated gas. But the action was always one of attraction, whilst, when there was no air at all present to be expanded and driven away by the hot platinum, the action was one of violent repulsion. A possible explanation of the attraction in air in this experiment may be given by assuming that the pendulum was driven inwards by the rush of cold air supplying the place of that rising upwards from the hot spiral; but it is not likely that this action should so completely overcome the effect of expansive action; and, moreover, it will only account for half the phenomenon (that in air), and leaves the still stronger action in a vacuum entirely unexplained.

FIG. 11.



119. I have tried special experiments to put the air-current theory to a decisive test. Bulb tubes (84) and torsion apparatus (102) have been prepared, containing terminals of metal, ivory, glass, mica, or pith, in the form of thin flat surfaces. These surfaces have been placed at an angle with the plane passing through the index and suspending thread in such a manner that the action of heat would be to cause currents and drive them round like the vane of a windmill. I, however, found the action of heat in *vacuo* to be repulsion, and in air to be attraction; and the latter was even strong enough to overcome the action of the air-currents, which could not fail to be developed under the circumstances of the experiment.

* The torsion apparatus with ivory terminals was exhibited in action at the meeting of the Royal Society, Dec. 11, 1873.
† June 20, 1874 (*Phil. Mag.*, August, 1874).

120. The pendulum apparatus has also been used to show that electricity is not the cause of the attraction and repulsion. On referring to the description (99) it is seen that the mass of magnesium forming the weight was in metallic contact with the platinum wire which supported it, and that the upper end of this platinum wire was fused into the glass tube, and passed thence to the outside. With this I have tried numerous experiments bearing on the action of electricity. I have connected the projecting end of the platinum wire with "earth," with either pole of an induction-coil (the other pole being more or less insulated), with either pole of a voltaic battery, and with a delicate electroscope; I have charged it with an electrophorus, and have submitted it to the most varied electrical conditions; and still, on allowing radiation to fall on the suspended mass, I invariably obtain attraction in air and repulsion in a vacuum. The heat has been applied from the outside, so as to pass through the glass, and also inside by means of the ignited spiral; and the results show no difference in kind, but only in degree, under electrical excitement. I often obtain troublesome electrical interference with the usual phenomena, but never of such a character as would lead me to imagine that the normal results were due to electricity. I also obtain the normal actions whether the apparatus has been standing insulated in the air, or whether it has been completely immersed in water connected electrically with "earth" or surrounded with wet blotting-paper.

121. The following experiment was suggested by Mr. Cromwell F. Varley, F.R.S., who informs me that he considers the results conclusive against the electrical theory. A torsion apparatus was prepared, as shown in fig. 11. The inside of the tube (*a b*) is lined with a cylinder of copper gauze, having holes cut in the centre (*c*) for the passage of the supporting thread (*d e*) and the index ray of light, and holes at each end to admit of the plates (*e, f*) being experimented with. A hole drilled in the plate (*b*) allows a wire to pass from the copper gauze to the outside, so as to give me electrical access to the gauze lining. Under the most diverse electrical conditions, whether insulated or connected with "earth," this apparatus behaves normally when heated; neither can I detect any electricity when the plate *e* or *f* is under the influence of radiation if I connect the wire *g* with a delicate electroscope. In experimenting with this apparatus I have also completely immersed it in liquids, such as water, solutions of metallic salts, ether, disulphide of carbon, &c. The heat has been applied in these cases by introducing a glass bulb containing water at different temperatures and a thermometer (28). Under all these varied circumstances the movements took place in a regular manner, and no electrical action whatever could be detected.

122. I have already discussed Prof. Osborne Reynolds's theory of evaporation and condensation somewhat fully in the already quoted Physical Society paper.* I will, however, describe the following experiments, which I think prove that Prof. Reynolds has not suggested a theory which accounts for all the facts of the case, and therefore has not hit upon the true explanation.

A thick and strong bulb was blown at the end of a piece of very difficultly fusible green glass, specially made for steam-boiler gauges. In it was supported a thin bar of aluminium at the end of a long platinum wire. The upper end of the wire was passed through the top of the tube and well sealed in for electrical purposes (120). The apparatus was sealed by fusion to the Sprengel pump, and exhaustion was kept going on for two days, until an induction spark refused to pass across the vacuum. During this time the bulb and its contents were several times raised to a dull red heat. At the end of two days' exhaustion the tube was found to behave in the same manner as, but in a stronger degree than, it would in a less perfectly exhausted apparatus, viz., it was repelled by light and heat of low intensity and attracted by cold.

A similar experiment was next tried, only water was placed in the bulb before exhaustion. The water was then boiled away *in vacuo*, and the exhaustion continued, with frequent heating of the apparatus to dull redness, for about forty-eight hours. At the end of this time the bar of aluminium was found to behave exactly the same as the one in the former experiment, being repelled by radiation.

Similar experiments, attended with similar results, were tried with a platinum and with a glass index; and instead of water, iodine has been put into the bulb to begin with.

It is impossible to conceive that in these experiments sufficient condensable gas or vapour was present to produce the effects Prof. Osborne Reynolds ascribes to it. After the repeated heating to redness at the highest attainable exhaustion, it is difficult to imagine that sufficient vapour or gas should condense on the movable index to be instantly driven off by a ray of light or even the warmth of the finger with recoil enough to drive backwards a heavy piece of metal.

123. It seems to me that a strong argument against Prof. Reynolds's theory (and also against the electrical and air-current theories) may be drawn from the fact that the repulsion in a vacuum is not confined to those red and ultra-red rays of the spectrum which mainly produce dilatation of mercury in a thermometer, excite an electrical current between antimony and bismuth couples, and cause a sensation of warmth when falling on the skin, but that any ray from the ultra-red to the ultra-violet will produce a similar effect. It cannot be reasonably argued that a ray of light, filtered through plates of glass and alum (109), can instantly vapourise a film of moisture or condensable gas from a surface on which it is caused to shine, or that it can produce air-currents in the almost perfect vacuum surrounding the surface shone upon, or that it will produce electrical excitement on such a surface.

124. Facts tested and verified by numerous experiments, but scarcely more than touched upon in the present paper, are, I think, gradually shaping themselves in order, in my mind, and will, I hope, aid me in evolving a theory which will account for all the phenomena. But I wish to avoid giving any theory on the subject until I have accumulated a sufficient number of these facts. The facts will then tell their own tale; the conditions under which they invariably occur will give the laws; and the theory will follow without much difficulty. In the eloquent words of Sir Humphry Davy, "When I consider the variety of theories which may be formed on the slender foundation of one or two facts, I am convinced that it is the business of the true philosopher to avoid them altogether. It is more laborious to accumulate facts than to reason concerning them; but one good experiment is of more value than the ingenuity of a brain like Newton's."

ON THE PHYSICAL AND CHEMICAL PROPERTIES OF RUTHENIUM.

By H. SAINTE-CLAIRE DEVILLE and H. DEBRAY.

RUTHENIUM, if heated in oxygen, is not transformed, like osmium, into a product volatile at 100°, but yields an oxide, RuO_2 , which does not sublime appreciably unless heated to bright redness. To obtain the hyper-ruthenic acid (RuO_4) of Claus, the analogue of osmic acid (OsO_4), it is necessary to attack ruthenium, well purified from osmium, with a mixture of nitre and potassa. It is thus converted into an orange-yellow soluble ruthenate, and the solution of this salt, saturated with chlorine and distilled in the water-bath in a current of this gas, yields volatile hyper-ruthenic acid, which condenses in gold-coloured globules or crystals. The ruthenium employed in the further experiments of the authors was obtained by

the reduction of this acid, and consequently cannot contain any trace of the other metals of the platinum group.

A solution of hyper-ruthenic acid in potassa, treated with alcohol, gives oxide of ruthenium, which is reduced to a metallic state by coal-gas at a temperature slightly elevated. The metal is afterwards alloyed in a crucible of charcoal made in a retort, purified by chlorine, with five or six times its weight of pure tin. The ingot, treated with boiling muriatic acid, which dissolves the excess of tin, leaves an alloy of ruthenium and of tin crystallised in cubes, having the planes of a rhomboidal dodecahedron (angles at 90° and 135°), and containing equal equivalents of tin and ruthenium. We grind it finely in a glass mortar, and it is introduced into a small boat of purified charcoal, which is strongly heated in a porcelain tube traversed by a current of dry and pure muriatic gas until the matter no longer loses weight. The tin is volatilised entirely in the state of protochloride, and we recover, without any loss, the weight of the ruthenium upon which we have operated, but it is transformed into a crystalline matter. We obtained for the density of this matter the following numbers:—

Weight in the air at 21° and 760 m.m. . . . 74.2490 grm.
Loss of weight in water at 21° 6.0265 grm.
Density at zero 12.261

We admit in all these calculations the coefficients of dilatation published by M. Fizeau in the *Annuaire du Bureau des Longitudes*.

The determination of pulverulent matters like ruthenium requires minute precautions, without which we do not obtain accordant numbers, even if we operate on one and the same substance. But we cannot describe here in detail the apparatus which we were obliged to employ to moisten completely the matter, and not to leave in the interior of the powder any trace of gas, and to avoid other causes of error.

When hyper-ruthenic acid is prepared by passing chlorine into a concentrated solution of the orange rutheniate of potassa, there is a moment when the liquor becomes deep green, and is filled with small black crystals. If we decant at this moment we may isolate the crystals, purify them from their mother-liquor and from chloride of potassium by a rapid washing, and finally dry them, first on unglazed porcelain, then in a vacuum over caustic potash and lime. These crystals have very brilliant planes, which are orthorhombic octahedra, derived from a prism of 117° . They are isomorphous with permanganate of potassa. The solution of this salt is a deep greenish black, like the salt itself. It decomposes very rapidly into oxide of ruthenium, which is deposited, and into orange rutheniate of potassa. Hyper-ruthenic acid, RuO_4 , does not seem able to combine with bases. If a fragment of it is dropped into solution of potassa it is dissolved very slowly, disengaging oxygen, and producing the deep green salt with which we are now engaged. This salt is composed of—

Ruthenium ..	1034	50.00	$\text{Ru}_2 = 50.34$
Potassa ..	469	22.44	$\text{KO} = 22.66$
Oxygen ..	569	27.46	$\text{O}_7 = 27.00$
Water ..	8	0.38	—
	2080	100.28	100.00

The salt, if weighed in a platinum boat placed in a glass tube, and gently heated in a current of hydrogen, takes fire, disengaging much water. If we replace hydrogen by carbonic acid a fresh quantity of water distils. If this water is collected in a chloride of calcium tube, and its weight determined, we may deduce the quantity of oxygen contained in the acid of the salt. There remains in the boat a mixture of ruthenium and of carbonate of potassa, which is weighed with the usual precautions, and which is separated with the greatest facility. Chlorine decomposes the new salt, $\text{Ru}_2\text{O}_7\text{KO}$, or $\text{Ru}_2\text{O}_7\text{K}$, taking possession of the potassium, and giving even at a common tem-

perature hyper-ruthenic acid, Ru_2O_8 , in vapour, without sensibly disengaging oxygen.

On this property is founded another method of analysis, which we have tried, and which gave results corresponding with those cited above. Conforming to the nomenclature adopted by M. Fremy when he discovered osmium acid, and respecting as much as possible the nomenclature of Claus, we shall propose to call—

Ruthenous Acid, RuO_3 , giving with potassa yellow-orange solutions.

Hepta-ruthenic Acid, Ru_2O_7 , giving with potash a black salt, of which the solution is deep green.

Finally, *Hyper-ruthenic Acid*, the acid RuO_4 of Claus, which does not combine with potassa, and of which the characteristic property is to be volatile, to possess even below 100° a considerable vapour-tension, and to decompose with explosion at 108° , as we have unhappily learnt at the expense of our stock of ruthenium.

Analysis of Ruthenium and its Alloys.—Though the purity of the ruthenium employed in our researches was guaranteed by its method of preparation, we have nevertheless analysed it. We shall describe in detail the method used for this analysis, which is suitable as well for pure ruthenium as for its alloys. We attack 0.5 grm. of ruthenium with a mixture of 5 grms. potassa and 2 grms. pure nitre in a gold crucible, and heat to redness. The metal disappears entirely, yielding a limpid liquid, which we dissolve in water after solidification and cooling. The crucible is washed with pure hypochlorite of soda, and the whole liquid transferred to a distillatory vessel of glass consisting of a balloon with a ground stopper, and fitted with two tubes blown to the balloon, one of which serves to introduce a current of chlorine into the liquid, and the other serves for the exit of the vapours disengaged, and conducts them into another balloon containing a solution of potassa. The ruthenite of potassa is first saturated with chlorine; the solution, at first orange, becomes a blackish green and then a golden yellow, because there are formed successively hepta-rutheniate, $\text{KO.Ru}_2\text{O}_7$, and hyper-ruthenic acid. We heated then the balloon in the water-bath to 80° , continuing to pass a slow current of chlorine. Yellow globules or crystals of hyper-ruthenic acid are condensed in the tube which connects the balloon of the receiver, and were gradually carried into the alkaline liquid. With 30 grms. of potassa in the receiver we are sure not to let hyper-ruthenic acid escape, if the current of chlorine is not intense enough completely to saturate the potassa. Nevertheless, we adapt to the receiver an abducting tube plunging into alcohol, which would arrest the least traces of hyper-ruthenic acid, and convert them into chloride of ruthenium. It must be noted that neither corks, nor especially caoutchouc, can serve to close or to connect the different pieces of this apparatus.

We must not expect to distil all the ruthenium in a single operation. We let the liquid of the balloon cool, we render it alkaline by adding a few pieces of potassa, and we recommence the preceding operation by putting into the receiver a fresh solution of potassa. If the liquid is no longer coloured, at first green then orange-yellow, on the first contact with alcohol, this is a proof that the distillation no longer gives hyper-ruthenic acid: the operation is then terminated.

To withdraw ruthenium from the alkaline solutions where it is condensed, we add to these a small quantity of alcohol; the greenish liquor becomes orange-yellow, then turbid, and deposits even in the cold oxide of ruthenium, retaining a little alkali, which is carried off by washing first with water, afterwards with a dilute solution of sal-ammoniac, and finally with pure water. The filter upon which we received the oxide of ruthenium is introduced into a counterpoised boat of porcelain, which is itself placed in a larger capsule covered with a funnel, by the tube of which coal-gas is caused to enter. When the air has been expelled from the funnel we heat the capsule on a gas-furnace at a temperature not exceeding 500° ; the oxide of ruthenium is reduced at first, and the paper is carbonised. We then

place the boat in the muffle of a gas-furnace, and burn there the carbon by heating it to dull redness. The oxide of ruthenium which is then formed is not yet volatile at such temperatures: there only remains to reduce it by purified hydrogen. For that purpose we introduce the boat into a glass tube, through which we pass hydrogen, which reduces the oxide with incandescence. We complete the reduction at dull redness, and allow to cool in a current of carbonic acid. We weigh the metal, after having washed it in water, which carries off traces of chloride of potassium. It is even indispensable to verify the weight of the metal after having digested it in a platinum vessel with diluted hydrofluoric acid, which dissolves a quantity of silica, often appreciable, derived from the vessels and filters. The 500 m.grms. of ruthenium taken yielded 498 m.grms. of metal, that is, four-thousandths of loss, which may be easily explained by the unavoidable removal of matter, produced when we attack the metal in the gold crucible in consequence of the disengagement of gas from the nitre. The liquid remaining in the balloon gave traces of iron, derived from hypochlorite, and 4.8 m.grms. of gold derived from the crucible. If we wish to determine the ruthenium contained in an alloy attackable by aqua regia we dissolve it, and after having evaporated the excess of acid introduce the solution of the chlorides into the distillatory apparatus described above, and add to it an excess of potassa and hypochlorite. This mixture, saturated with chlorine and distilled as has been said, gives off, after one or several treatments with potassa and chlorine, all its ruthenium in a state of volatile hyper-ruthenic acid. Our note of November 15, 1875, contains the method which is proper to employ in the case where ruthenium is associated with iridium, and forms with it an alloy unattackable in aqua regia. We shall only recall that it is by the aid of baryta and nitrate of baryta, or bi-oxide of barium, that we cause these metals to enter into solution. Thus, transforming the ruthenium into a very volatile product, which does not permit it to be confounded with any other body, we give to the determination of this metal a security which cannot be obtained by any other method.—*Comptes Rendus*.

ON ANTHRACEN TESTING.

By R. LUCAS.

EXPERIENCE with the "anthraquinon test" has taught us that the anthraquinon obtained is not pure anthraquinon. I have made some experiments to obtain chemically pure anthraquinon by increasing the quantity of chromic acid. By taking 15 grms. of chromic acid and boiling for four hours without using the "appendix," I obtained the same results as with the usual anthraquinon test with appendix. I now increased the chromic acid to 20 grms. and boiled for six hours, but there was no alteration in the result, and the chromic acid seems not to act further on the impurities so long as the chromium salt and oxidation products are present. But if we finish the test in the usual way, and treat the anthraquinon again with chromic acid, some of the impurities are destroyed, but the result is not chemically pure anthraquinon. Dr. Versmann published in the *CHEMICAL NEWS* (vol. xxiv., pp. 178, 192, and 202) some very interesting experiments on anthraquinon, and he proposed (*CHEMICAL NEWS*, vol. xxiv., p. 178) a new anthracen test by separating the crystals and powder resulting from the anthraquinon test. I have tested a number of samples of anthracen by Dr. Versmann's new test and examined the crystals and powders separately for anthraquinon. The crystals which I obtained by Dr. Versmann's method were not all chemically pure anthraquinon; they lost in weight when treated by the anthraquinon test. The powders I dissolved in glacial acetic acid and separated them each

again in crystals and powder. The crystals obtained in this way contained a large quantity of anthraquinon, which I have converted into alizarin, and even the powder contained still a small quantity of anthraquinon.

The determination of the melting and solidifying-point of the powder has no practical value; it only might teach us that the powder is not pure anthraquinon, but it does not show us whether it contains anthraquinon, just what we want to know in our case.

We know that a small amount of impurities alters the melting-point of organic substances considerably, and we are not justified to accept Dr. Versmann's compromise by considering the powder as valueless impurity in all cases where the melting- and solidifying-point is below 270° or above 280° C. It is nearly impossible to determine the "exact" melting-point of the powders on account of the dark colour which some of them assume on being heated. This alone would lead to disputes, and the results of Dr. Versmann's new test will be in most cases too low.

How misleading the determination of melting-points sometimes are we know if we go back to the time of the alcohol test, where samples of anthracen were rejected "as containing no anthracen at all," because the melting-point was under 190° C. I have tested some of these identical residues of the alcohol test of the low melting-point of 170° C. by the anthraquinon test, and found that they contain more real anthracen than other residues showing the melting-point of 205° C., and in the case of refined anthracen the melting-point shows nothing at all. I have tested a number of samples all of the same mean melting-point, 210° C., by the quinon test, and their percentage varied from 45 per cent to 99.5 per cent of anthracen.

Of all the anthracen tests which have been published Messrs. Meister, Lucius, and Brüning's "new and improved test" (*CHEMICAL NEWS*, vol. xxiv., p. 167; treatment of the quinon with fuming sulphuric acid, &c., comes the nearest to the truth. The anthraquinon obtained by this test is not chemically pure, and Meister, Lucius, and Brüning stipulate, therefore, to volatilise the product obtained and to deduct the carbon and ash from the weight of the anthraquinon, and only the volatile part represents the pure anthraquinon. The volatilisation of the quinon is objectionable, because it is very difficult to volatilise the anthraquinon completely without burning some of the carbon. Chemically pure anthraquinon can be volatilised completely without leaving a mark if heated carefully, but if it is heated too quick and some drops of the anthraquinon fall back on the heated bottom of the crucible some carbon remains.

To overcome this difficulty of volatilising the quinon, and to make the test more exact, I propose the following alteration and addition to Messrs. Meister, Lucius, and Brüning's new test. Instead of volatilising the quinon, I dry it on the filter and treat it again by the anthraquinon test with chromic acid. The whole test would now read as follows:—

Take 1 grm. of anthracen, place it in a flask of 500 c.c. capacity with upright condenser, add to it 45 c.c. of glacial acetic acid, and heat to ebullition. To this solution (which is kept boiling) add, drop by drop, a solution of 15 grms. of chromic acid in 10 c.c. of glacial acetic acid and 10 c.c. of water. The addition of the chromic solution should occupy two hours, after which the liquid is to be kept boiling for two hours longer, four hours being required to complete the oxidation. The flask with its contents is to be kept standing for twelve hours, then mixed with 400 c.c. of cold water, and again kept standing for three hours. The precipitated anthraquinon is now collected on a filter, and washed, first with pure water, then with boiling dilute alkaline solution, and finally with pure water. The quinon is now washed from the filter into a flat dish and dried at 100° C. It is then mixed in the same dish with 10 times its weight of fuming sulphuric acid (sp. gr. 1.88) and heated to 100° C. for ten minutes on a water-bath. It is then taken at once from the water-bath

and kept in the same dish for twelve hours in a damp place to absorb moisture. Then add 200 c.c. of cold water to the contents of the dish, collect the precipitated quinin on a filter, and wash, first with pure water, then with boiling alkaline solution, and again with pure hot water, and finally dry.

The quinin is now removed from the filter and put into a flask of 500 c.c. capacity, and the small quantity of quinin remaining on the filter paper is washed off with 45 c.c. of hot glacial acetic acid into the same flask. Now heat to boiling and add slowly a solution of 15 grms. of chromic acid in 10 c.c. of glacial acetic acid and 10 c.c. of water and boil for four hours. The flask with its contents is kept for twelve hours, then mixed with 400 c.c. of cold water, and again kept standing for three hours. The precipitated anthraquinon is now collected on a double filter, and washed, first with pure water, then with boiling dilute alkaline solution, and again with pure water, and finally dried at 100° C. until constant in weight. The weight of the quinin obtained is to be calculated in the usual manner into anthracen. The quinin obtained should always be tested for ash, and the weight of the ash deducted from the weight of the quinin before calculating it into anthracen.

A few words about anthracen might be interesting to tar distillers. Some people believe that anthracen showing a low percentage is identical with a low quality anthracen, and that a high percentage anthracen must always be of good quality. This is an error. Some tar distillers push the distillation of the tar or of the anthracen oils too far and they get an anthracen of inferior quality, because it is principally the last portion of the distillate containing the so-called pitch anthracen, which is of inferior quality, and some of the alizarin makers stipulate, therefore, in their contracts "the anthracen must not be made from pitch." My experience is that anthracen of bad quality cannot be improved by simply pressing, and that the quality is not always improved by washing with solvents. But the quality of inferior anthracen is improved (1) if the anthracen in question has not been filtered and pressed by a re-distillation of the same, leaving the last portion as pitch in the still, and (2) if the anthracen has already been pressed by a systematical re-crystallisation from solvents.

THE POTASH THEORY OF SCURVY.

THE discussion which has recently been carried on in the columns of *The Times* respecting the outbreak of scurvy on board the "Arctic" vessels has recalled to our notice an article published in this journal in 1867 (*CHEMICAL NEWS*, vol. xv., p. 37), in which we referred to the views of the late Baron Liebig and other high authorities, who held that the value of lime-juice as an anti-scorbutic is due solely to the potash which it contains. It may serve a useful purpose if we reproduce extracts from this article. At any rate they will show the importance of lime-juice being tested by competent analysts:—

"Lime-juice is used in the English Navy and Merchant Service as an efficient anti-scorbutic. Amongst American seamen scurvy is almost unknown, and this immunity has been ascribed to the very general use of potatoes; whilst in France and Russia the rareness of this disease is similarly ascribed to the almost universal consumption of thin light wines as a beverage. Rice, which has been frequently proposed as a substitute for potatoes, has, however, been proved to be utterly valueless as an anti-scorbutic. Again, the evil effects of salt meat are notorious, but fresh beef alone is capable of preserving health for almost any time.

"These facts are found to agree perfectly with the potash theory of scurvy. The mineral constituents of lemon-juice are found to be extremely rich in potash, containing, according to Mr. Witt, upwards of 44 per cent of

this alkali. There is an opinion that the juice of the lime (*Citrus limetta*) is stronger and more acid than lemon-juice, but in chemical constitution there is not much difference between the two. Fresh vegetables, as a rule, are rich in potash salts; potatoes, which may be placed at the head, containing no less than 51 per cent in their ash, according to Way and Ogston, and 55 according to Griepenkerl. Grape-juice, which may be considered as the representative of the light wines so largely used in the French and Russian marine, contains in its ash from 60 to 70 per cent of potash, while the husks of grapes have an ash containing 37 per cent. Rice, however, contains only 20 per cent in its ash.

"Dr. Garrod, who has examined various kinds of food in reference to this point, gives the actual amount of potash contained in different alimentary substances. From this we learn that—

One ounce of rice	contains 0.005 gr. of potash.
" lemon-juice	" 0.852 "
" boiled potato	" 1.875 "
" raw beef	" 9.599 "
" salt beef	" 0.394 "

"But without assuming that the active principle of these various anti-scorbutic foods is the potash which they contain, there is no doubt whatever that chemical analysis is abundantly able to show the quality of lime-juice in an accurate and rapid manner. The constituents of lime-juice are not many, the organic part contains citric acid, mucus, vegetable albumen, pectin, and sugar; whilst the inorganic constituents consist nearly half of potash, and the rest of the ordinary ingredients of the ash of plants. It is certain that most of these have no action as far as scurvy is concerned, and a little investigation could not fail to show whether the specific consisted of the potash or some other constituent. The work of the analyst would then be to see generally that the article was in a state fit for food and likely to keep, and specially to see that the percentage of the active ingredient did not sink below a certain standard. Too much stress has been laid on the considerable time which it is supposed lime-juice would take to analyse; and Dr. Leach has stated 'authoritatively that any juice may be safely pronounced good, bad, or indifferent in from twenty to thirty hours after its receipt by the inspecting officer.' This is far longer than would be required. When once the appliances for such analyses were in working order, we do not hesitate to say that a skilful chemist would supply all the necessary information in a couple of hours.

"Assuming, as will most likely prove to be the case, that the potash salts are the specific agents against scurvy, chemical analysis is seen to be indispensable in the selection of anti-scorbutics for use on board ship. It then, however, becomes a question whether the active agent could not be stored and administered with far more economy, ease, and efficacy in the form of some convenient pharmaceutical preparation (such as the granulated effervescing citrate of potash) than when given through the exceedingly unscientific, clumsy, and oftentimes repulsive expedient of serving out lemon-juice to the men. It might also be worth while to ascertain whether the desired end could not be secured by letting chloride of potassium partially replace chloride of sodium in the preservative processes to which the provisions are subjected.

"Whether every sample of lime-juice should be separately examined before shipment, or whether Dr. Stone's suggestion be adopted of licensing a limited number of lime-juice vendors, and occasionally verifying the genuineness of their commodity by analysis, is a matter which need not at present be discussed."

University of London.—The following candidate has passed the recent examination in Public Health:—H. Franklin Parsons, M.D. (gold medal), St. Mary's Hospital.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

December 16th, 1876.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidate was elected a Member of the Society:—Mr. W. Baily, M.A.

Mr. Crookes described some of the most recent results he has obtained in his experiments on the radiometer, and exhibited many beautiful forms of the apparatus, most of which have been devised with a view to decide on the correct theory of the instrument. He commenced by describing the arrangement he has used for some time past in studying the resistance offered by air and other gases to the rotation of a mica disc. It consists of a mica plate suspended by a fibre of glass, and enclosed in a chamber which can be exhausted to any required extent. A mirror is attached to the mica, and the movement of a luminous point reflected from it shows that the decreasing swings form a logarithmic curve, and Mr. Crookes takes the logarithms of the decrements of the swings as a measure of the viscosity of the gas under examination. From the normal atmospheric pressure to the best vacuum which can be obtained by the ordinary air-pump this decrement remains nearly constant, and these experiments have been carried on in vacua of remarkable perfectness, the highest exhaustion obtained being represented by 1 millimetre on a scale of 10 miles, a point which was attained by means of a Sprengel pump with improvements by Mr. Gimingham, and measured by a McLeod gauge. If the "logarithmic decrement" be represented by 125 at a pressure of 760 m.m., it is not reduced to 70 until the pressure has been reduced to 35-millionths of an atmosphere, and at this point the action of light on a radiometer is at a maximum. On continuing the exhaustion this influence is found to decrease, and Mr. Crookes concludes that in a perfect vacuum the log dec. would not be zero, but about 0.01; that is, a mica plate would not continue to oscillate for ever, a fact probably due to the viscosity of the glass fibre. About fifteen different forms of the radiometer were exhibited, and their inventor has satisfied himself that the theory of their action proposed by Mr. G. Johnstone Stoney is the only one capable of completely accounting for their action, and he considers it to be in all probability the correct one. By means of a double radiometer, consisting of two globes of different diameters, and having a wide opening between them, and provided with a four-armed fly which can be made to rotate in either bulb, it has been shown that, other things being equal, the velocity of rotation decreases as we increase the diameter of the bulb. As, on the molecular-movement theory, the rotation is due to a throwing off of particles from the blackened surface of the mica, it follows that, if a piece of transparent mica be attached to each fly in front of the blackened surface, the rotation will take place in the opposite direction, and this proved on experiment to be the case. And, further, when such a plate is placed on either side of the vanes, the motion of the instrument is almost entirely stopped. As these facts can be explained on the "molecular movement" or the "evaporation and condensation" theory, Mr. Crookes arranged a radiometer having four transparent mica vanes, and mounted in a rather large bulb. At the side of the bulb a plate of mica, blackened on one side, is so fixed in a vertical plane that the vanes can pass, and when light shines on this fixed plate the fly is found to rotate, a fact which in itself disproves the latter theory. Many other curious forms were exhibited, in some of which the vanes were cup-shaped, as Mr. Crookes has found these to act as well as the ordinary form, a convex surface acting as though it were blackened. In conclusion, he exhibited a photometric four-vaned radiometer, in which the fly was

attached to a small magnetic needle, and this might be so checked by an external magnet that the strongest light would be incapable of causing the needle and vanes to make a half rotation. If the circumference of the globe be graduated, and the apparatus be brought within the influence of a source of light, the angle to which the needle is deflected will be a direct measure of the intensity of the light, and Mr. Crookes showed that by a simple arrangement such an instrument might be rendered self-recording.

Prof. DEWAR exhibited a simple electrometer which he has designed, founded on the discovery of Leipman that the capillary constant is not really independent of the temperature or the condition of the surface, but is a function of the electromotive force. If a capillary tube be immersed in mercury, and dilute sulphuric acid be placed in the tube above the mercury, and a current from a Daniel's cell be so passed through the liquids that the mercury forms the negative pole, the column will be depressed to an extent dependent on the diameter of the tube. In making an electrometer, Prof. Dewar has increased the sensitiveness by connecting two vessels of mercury by means of a horizontal glass tube filled with the metal, except that it contains a bubble of dilute acid. The tube must have an internal diameter of 2 millimetres, and it is essential that it be perfectly clean, uniform in diameter, and horizontal. The instruments exhibited were constructed by Messrs. Tisley and Spiller, and Prof. Dewar showed that it is possible by means of them to measure an electromotive force equal to 1-10,000th of a Daniel's cell; forces capable of decomposing water must be measured by causing two currents to act against each other. The index bubble is brought to zero by uniting the mercury cups by a wire. The apparatus is very convenient, as it requires no preparation, and is extremely simple in its action. He then showed an instrument arranged by Mr. Tisley for producing a current by the dropping of mercury from a small orifice into dilute sulphuric acid. If the vessels containing the mercury and the sulphuric acid be connected by a wire a current is found to traverse it, and Prof. Dewar explained how the electrolysis of water might be effected by this means. He then exhibited a delicate manometer suitable for measuring very slight variations of pressure, and he illustrated the use of it for proving Laplace's law that the internal pressure, multiplied by the diameter of a soap-bubble, is constant. It consists of a U-tube, one arm of which is about 15 inches long, and is bent horizontally, and levelled with great care. If the shorter arm be connected with a tube on which a bubble has been blown, and the diameter of the bubble be varied, the position of the extremity of the alcohol column will be found to vary in accordance with the above law.

DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

November 27th, 1876.

Prof. A. W. HOFMANN, F.R.S., President, in the Chair.

F. WÖHLER, "*Action of Palladium in an Alcohol Flame.*" Palladium held in an alcohol flame is rapidly covered with carbon. The author supposed this to be due to its affinity for hydrogen, but finds by experiment that palladium does not decompose ethylen and the various gases of the alcohol flame below a red heat, although below the decomposing temperature of ethylen. He suggests the possibility of a temporary absorption of hydrogen, as in the case of copper heated in ammonia gas.

E. BAUMANN, "*Synthesis of Hydrogen-Phenyl-Sulphate and its Homologues.*" This compound, which the author discovered in urine, is easily obtained by the action of pyrosulphate of potassium, $K_2S_2O_7$, on a concentrated aqueous solution of potassium phenylate. Corresponding compounds of cresol and resorcin are obtained in a similar way.

H. WILLGERODT, "Action of α -Dinitro-chloro-benzol upon Acetamide." The two alone give no reaction at a temperature of 150° , but upon addition of magnesia ortho-para-nitraniline is obtained. The reaction with acetamide is much more difficult than that with oxamide.

H. WILLGERODT, "Action of α -Dinitro-chloro-benzol upon Carbamide." The reaction has been studied under a great variety of circumstances in the attempt to introduce the dinitro-phenyl radical into carbamide. In all cases, however, dinitraniline (melting-point 180°) has been obtained, and the carbamide has been completely decomposed.

L. F. NILSON, "Plato-nitrites and Diplato-nitrites." The author has studied the double nitrites of platinum monoxide and the metals. He regards these compounds as containing the radical $(\text{PtO}_2(\text{NO}))_4$, which he terms *plato-tetra-nitrosyl*. The acid previously regarded as acid nitrite of platinum is plato-nitrosylic acid, and the salts plato-nitrites. With some metals he has obtained diplato-nitrites, containing the radical $\text{Pt}_2\text{O}_3(\text{NO})_4$. Salts have been prepared with thirty various metals. These salts are generally obtained as fine crystals, are as a rule easily soluble in water, and not decomposed at 100° . Beryllium, iron, and indium form diplato-nitrites only.

ALBERT ATTERBERG, "Derivatives from α -Dinitro-naphthalin and β -Dinitro-naphthalin." From α -dinitro-naphthalin the following compounds have been prepared:—dinitro- γ -dichloro-naphthalin, $\text{C}_{10}\text{H}_4\text{Cl}_2\cdot 2\text{NO}_2$; chloro-naphthylamin-hydrochlorate, $\text{C}_{10}\text{H}_6\text{Cl}\cdot\text{H}_2\text{N}\cdot\text{HCl}$; chloro-naphthylamin-sulphate, $\text{C}_{10}\text{H}_6\text{Cl}\cdot\text{H}_2\text{N}\cdot\text{H}_2\text{SO}_4$; and chloro-naphthylamin, $\text{C}_{10}\text{H}_6\text{Cl}\cdot\text{NH}_2$. β -dinitro-naphthalin on treatment with phosphoric pentachloride yields large quantities of δ -trichlor-naphthalin, with a small amount of a new dichlor-naphthalin, which receives the distinctive mark ζ . The properties of δ -trichlor-naphthalin have been thoroughly examined, and the compound changed into a dichloro-phthalic acid, showing that only two of the three chlorine atoms are upon the same half of the naphthalin molecule.

A. ATTERBERG, "On the Constitution of some Naphthalin Compounds." A consideration of the positions in the naphthalin molecule of doubly- and trebly-substituted chlorine derivatives.

KARL HEUMANN, "Apparatus for the Representation of the Manufacture of Sulphuric Acid." A description of an ingenious arrangement for a lecture experiment.

W. THÖRNER, "Derivatives of Para-tolyl-phenyl-ketone." By the treatment of para-benzoyl-benzo-trichloride, $\text{C}_6\text{H}_5\text{—CO—C}_6\text{H}_4\text{—CCl}_3$, resulting from the action of chlorine upon para-tolyl-phenyl-ketone; with phosphoric pentachloride oxygen is replaced by chlorine, and a ketone pentachloride obtained. The rest of the paper is occupied with theoretical considerations upon the structure of the two isomeric benzo-pinacolins resulting from the reduction of para-tolyl-phenyl-ketone, and accounts of experiments undertaken with this object in view. To α -pinacolin he assigns a formula analogous to that of pinacon, while β -pinacolin is regarded as being similar in structure to the pinacolins of the fatty series.

H. BRUNNER, "Preliminary Notice on the Action of Silver Nitrite upon Iodo-benzyl, of Silver Nitrite and Potassium Nitrite upon Chlor-benzyl, and of Silver Nitrate upon Chlor-benzyl." The results obtained are as yet of no particular value.

R. V. D. VELDEN and E. BAUMANN, "Action of the Turpentine upon Animal Organisms." Numerous experiments show the falsity of the statement that pure oil of turpentine, and bodies belonging to the same class, form compound ethers with the sulphuric acid present in animal organisms. Previous statements upon this subject are probably due to the fact that the turpentine experimented upon were not free from essential oils, or such substances as thymol, containing oxygen, and entering easily into combination with sulphuric acid.

E. BAUMANN and E. HEETER, "Action of the Homologues of Phenol upon Animal Organisms." The various cresols, thymol, resorcin, and other homologues of phenol, possess

the latter's property of forming compounds similar to hydrogen-phenyl-sulphate on entering the animal organism. Substituted phenols possessing the character of an acid do not, however, show this reaction.

P. HUNAU, "On Citric Acid and Aconitic Acid." In the course of investigations upon the constitution of citric acid the following compounds were obtained:—Trimethyl-citrate, $\text{C}_9\text{H}_{14}\text{O}_7$, by the saturation of an alcoholic solution of citric acid with gaseous hydrochloric acid, triclinic crystals melting at 79° ; acetyl-trimethyl-citrate, by treatment of the preceding compound with acetyl-chloride, a colourless liquid boiling at 280° ; and trimethyl-monochloro-tricarballoyate, $\text{C}_9\text{H}_{13}\text{ClO}_6$, obtained by the action of phosphoric pentachloride upon the first compound, a heavy colourless oil; heating changes it into trimethyl-aconitate. Aconitic acid he obtained easily in large quantities by first leading gaseous hydrochloric acid into citric acid at a temperature of 140° , dissolving in a little water, evaporating to dryness, and then following the customary method.

A. MICHAEL and T. H. NORTON, "Preparation and Properties of Tri-iodo-resorcin." Iodine monochloride added to a cold aqueous solution of resorcin gives an insoluble precipitate of tri-iodo-resorcin, $\text{C}_6\text{H}_3(\text{IO})_3$. The crystals obtained from a solution in alcohol or carbon disulphide melt at 145° , and are changed by nitric acid into styphnic acid, $\text{C}_6\text{H}(\text{HO})_2(\text{NO}_2)_3$. The reaction is somewhat uncommon. Treatment of pyrogallallic acid with iodine monochloride gives no results.

OTTO FISCHER, "On the Phthaleins of Tertiary Aromatic Bases." The author has obtained dimethyl-aniline-phthalein by the action of phosphoric anhydride or other dehydrating bodies upon a mixture of dimethyl-aniline and phthalic anhydride or phthalic chloride. It is of a deep green, soluble in most dissolving agents, and possesses all the properties of a colouring principle. With hydrochloric acid, picric acid, &c., it forms two series of salts, the green ones containing one molecule of acid, and the yellow two molecules. By reduction, as in the case of phenol phthalein, two atoms of hydrogen are taken up, and another new base, giving well defined salts, is obtained. Other tertiary compounds, such as methyl-diphenylamine, yield also, by the above reaction, green colouring matters.

W. STAEDEL and L. RUGHEIMER, "On the Action of Ammonia upon Chlor-acetyl-benzol." Two compounds result from this reaction, both possessing the formula $\text{C}_6\text{H}_5\text{O}_2\text{Cl}$. The first melts at 117° , and is easily oxidised, yielding benzoic acid. The second melts at 154° , is more insoluble than the first, and is oxidised with greater difficulty, yielding another aromatic acid as well as benzoic acid.

T. ZINCKE, "Action of Dilute Sulphuric Acid upon Hydrobenzoin and Iso-hydrobenzoin: on Pinacone and Pinacoline." Hydrobenzoin and iso-hydrobenzoin give each with sulphuric acid a liquid and a solid crystalline compound. Both of the liquids were found to consist of the aldehyd of diphenyl-acetic acid. The solids possess alike the formula $\text{C}_{14}\text{H}_{12}\text{O}_4$, have different physical properties, but identical chemical properties. From theoretical considerations the author regards these bodies as the same compound in different physical conditions, and views hydrobenzoin and iso-hydrobenzoin as identical, explaining their differences in the same manner, and placing them in the class of pinacones.

A. BLATZBECKER and T. ZINCKE, "On Benzyl-isophthalic Acid." This acid, $\text{C}_6\text{H}_5\text{C}_6\text{H}_3(\text{COOH})_2$, is obtained from benzyl-isoxylol by oxidation with potassium bichromate and sulphuric acid. It melts at 278° . Various salts and ethers have been prepared. By reduction with zinc and hydrochloric acid benz-hydryl-isophthalic anhydride is obtained, $\text{C}_{15}\text{H}_{10}\text{O}_4$. Sodium amalgam gives the dibasic benzyl-isophthalic acid, $\text{C}_6\text{H}_5\text{CH}_2\cdot\text{C}_6\text{H}_3(\text{COOH})_2$.

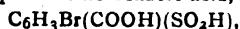
L. KLIPPERT and T. ZINCKE, "On Para-Xylenic Acid." The authors have obtained from para-dichlor-xylyl, by means of the dicyanide para-xylic acid,
 $\text{C}_6\text{H}_7(\text{CH}_2\text{COOH})_2$.

It yields easily crystallisable salts and ethers, a number of which have been prepared.

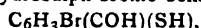
C. LIEBERMANN and M. WALDSTEIN, "*Emodin from the Bark of the Rhamnus frangula*." An examination of the acid in the bark of the *Rhamnus frangula*, termed by its discoverer, Faust, frangulic acid, shows it to be identical with emodin, $C_{15}H_{10}O_5$. This new source of emodin allows of its being produced much more cheaply and easily than by the method now in use.

C. LIEBERMANN, "*Constitution of Oxythymo-quinon*." From the comparison of numerous closely related compounds in the naphthalin group, the author condemns the formula of Ladenburg in his lately issued work on "*The Theory of the Aromatic Compounds*."

C. BÖTTINGER, "*Action of Zinc-dust on the Chlorides of Sulpho-para-bromo-benzoic Acid*." This reaction yields a mixture of the following four compounds, the separation and purification of which are attended with great difficulty:—Sulphi-para-bromo-benzoic acid,



crystallises in fine needles, and is decomposed by heating. Sulphi-bromo-benzaldehyd, $C_6H_3Br(COH)(SO_2H)$, has an odour similar to that of the oil of bitter almonds, and melts at 131° . Hydrosulph-bromo-benzaldehyd,



and hydrosulph-bromo-benzoic acid, $C_6H_3Br(COOH)(SH)$, are both easily decomposed.

B. ARONHEIM, "*On the Use of Molybdenum Pentachloride for the Production of Organic Chlorides*." The joint action of this body and chlorine gas is the same as that of antimony, penta-chloride, and chlorine, forming with organic bodies highly chlorinated compounds; carbon disulphide, for example, is changed into carbon tetrachloride. It also serves admirably for the substitution of chlorine for hydrogen in benzol when the latter contains likewise substituted hydrocarbons which it is desirable to leave intact.

B. ARONHEIM, "*Synthesis of Tolylyl-butylene*." This compound, $(CH_3.C_6H_4).CH_2.C_3H_5$, one of the few non-saturated hydrocarbon substitution derivatives of benzol, is obtained from the action of allyl-iodide and sodium upon meta-xylyl-chloride. It is a colourless oil, boiling at 195° , and forming addition compounds with the halogens.

Monday, December 11, 1876.

G. KRÄMER and H. TROSCHE, "*On Methyl-alcohol and Dimethyl-acetal*." The authors describe methods for obtaining methyl-alcohol chemically pure, and analytical experiments on the constitution of dimethyl-acetal.

G. KRÄMER and H. TROSCHE, "*On the Aldehyds and Ketones present in Wood-spirit*." By submitting enormous quantities of crude methyl-alcohol to fractional distillation, the following bodies were obtained:—Methyl-aldehyd, ethyl-aldehyd, methyl-ethyl-ketone, dimethyl-ketone, amyl-ketone, and three new bodies possessing the characteristics of ketones. The first possesses the formula $C_7H_{12}O$, and is probably a condensed ketone. The next, $C_8H_{14}O$, boils at 135° , produces by oxidation large quantities of acetic acid, and by treatment with sulphuric acid yields xylo, C_8H_{10} . The third boils above 300° , yields with sulphuric acid cymol, $C_{10}H_{14}$, and receives the formula $C_{10}H_{16}O$.

C. LIEBERMANN, "*On the Formula of Brazilin*." Brazilin, the red colouring matter of Brazil wood, has hitherto received the formula of $C_{22}H_{20}O_7$. The author considers $C_{16}H_{14}O_5$ as more correct. It possesses many points of similarity with the colouring matter of logwood, hæmatoxylin, $C_{16}H_{14}O_6$, and, where the latter, by decomposition, yields pyrogallic acid, Brazilin yields resorcin. He has prepared tetracetyl-brazilin, $C_{16}H_{10}(C_2H_3O)_4O_5$, the lead salt, $C_{16}H_{12}PbO_5 + H_2O$, and halogen compounds of the general formula $C_{16}H_{12}Cl_2O_5$.

A. FRANCK, "*Action of Water on Glass*." The author

finds glass of the following composition best suited to resist the decomposing influence of steam—



An easy method to determine the value of glass in this respect is to boil a finely pulverised sample for some time with water, and notice the decrease in weight. This amounts in some instances to 10 per cent.

NOTICES OF BOOKS.

Chemia Coartata, or the Key to Modern Chemistry. By A. H. KOLLMAYER, A.M., M.D. London: J. and A. Churchill.

THIS work is singular in its shape—which more nearly approaches that of a cheque-book than of any ordinary volume—a peculiarity due to the tabular form which the author has adopted. His main object has been "to compress into as small space as possible everything connected with the study that deserves attention, and to give no more explanatory matter than is actually required to render each subject perfectly intelligible," and he certainly has succeeded in condensing a wonderful amount of matter into very little space. The work is said to be especially adapted to the wants of three classes of persons: "Students intending to present themselves for examinations—to whom, as a rule, we should offer the general advice 'don't!'—secondly, persons who have learned the old notation and—not believing in the adage that a rose by any name will smell as sweet—wish to become acquainted with the *modern system*; and, lastly, those who desire to keep themselves posted on this subject, and who can thus easily refresh their memories without doing so at the expense of their other engagements."

The work, after a few introductory remarks, opens with the usual table of elementary bodies, symbols, and atomic weights. The laws of combination, the all-important subject of quantivalence, chemical formulae, and equations are then explained. Next follows the main division of the subject.

Opposite the name of each element are placed, in parallel columns, its synonyms, its history, sources, equations (this latter term being used in a somewhat wide sense, including such directions as "Union can be effected by the aid of an electric spark passed through the mixed gases"); its properties arranged in two columns, the former containing its symbol, combining weight, specific gravity, weight of a litre, and of 100 cubic inches; and, lastly its characteristic tests. Some of the information given is, however, either defective or not happily selected. Thus under the potassium compounds we find no mention of their greatest modern source, the Stassfurt salts. The nitrates of potash and soda, we are told, occur naturally in India and Peru respectively. But when we turn to sodium chloride we find that it is "manufactured in England, Spain, and Canada." Surely it would have been more instructive to have stated that it occurs naturally in England, Poland, and North-Western India. Under aluminium we read that the white precipitate given by ammonia is insoluble in excess, which is by no means absolutely correct. The instructions for the preparation of common alum are also likely to mislead. It is prepared, we are told, from "aluminous clay"—are not all clays aluminous?—"which is roasted, exposed to air, lixiviated with water, sal-ammoniac added to remove iron, and the solution then crystallised." Under iron we read, in the column indicating its sources, "found pure and as sulphide." Why the sulphide should be named as a source for iron in preference to the oxides is doubtful.

In organic chemistry the multitude of compounds has rendered it impossible for the author to carry out his

tabular form except with certain groups, such as the alcohols and the cyanogen compounds. In general, however, space does not allow him to do more than define such classes as the ketones, amines, phosphines, &c.

The last portion of the work is a synopsis of poisons with their antidotes and general treatment.

The work upon the whole may be pronounced useful, and we hope that a future edition may see it freed from the oversights which we have pointed out, from certain typographical errors, and from the repetition of matter in different places.

Notes on Certain Explosive Agents. By WALTER N. HILL, S.B., Chemist at the U.S. Torpedo Station. Boston: J. Allyn.

THIS work treats first of explosions and explosive bodies in general; then of nitro-glycerin and its commercial mixtures; and of gun-cotton, which, with Prof. Abel, the author regards as trinitro-cellulose, and which he distinguishes from the lower substitution products used for making collodion. Like most chemists he admits the impossibility of sulphuric acid remaining in gun-cotton after it has undergone the process of washing, directed under Abel's patent, and concurs in the conclusion arrived at in England that the Stowmarket explosion must have been caused by the intentional addition of sulphuric acid to the finished product.

The picrates and fulminates used as explosives are next described. In considering the respective forces of the agents in question he pronounces nitro-glycerin eight times as powerful as gun-powder, dynamite six times, and gun-cotton from four to six times. He draws, however, a very important distinction. "The harder and firmer the material to be blasted the more effective, proportionally nitro-glycerin or gun-cotton will be. In soft materials the reverse is true."

As regards comparative safety he considers both nitro-glycerin and gun-cotton to have the advantage over gun-powder.

Disease of the Sugar Cane, Queensland. By Professor LIVERSIDGE. Sydney: Gibbs, Shallard, and Co.

EPIDEMIC disease among important crops seems to be on the increase. The potato and the vine have long been sufferers, and, according to a writer in the *Comptes Rendus* the latter is now attacked by a new malady, quite distinct from the effects of the phylloxera. The coffee plantations of Ceylon are said to be withering away from some unexplained cause, and now the sugar cane in Queensland is affected with a disease, which is locally known as "rust." Prof. Liversidge, of the University of Sydney, who has made an official examination of the diseased canes and the soils in which they grow, does not consider that the malady springs from some one specific cause, but is due to imperfect cultivation, of which he certainly points out some decided proofs.

Proceedings of the Madras Government, Public Works Department. February 21st and December 10th, 1874.

A REPORT from Surgeon E. Nicholson on the qualities of limestones and cements.

Sanitary Effects of Eucalyptus Globulus.—Between Nice and Monaco there is a locality so unhealthy that the Paris, Lyons, and Mediterranean Railway Company have been obliged to change every two or three months the watchman at a crossing there. Plantations of the *Eucalyptus* have been formed there, and at present the same watchman has resided there for several months with his family without experiencing the least inconvenience. —*Les Mondes.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances, de l'Academie des Sciences. No. 21, November 20, 1876.

Physical and Chemical Properties of Ruthenium.—MM. H. Sainte-Claire Deville and H. Debray.—(See page 265.)

New Researches on the Chemical Phenomena Produced by Electricity of Tension.—M. Berthelot. —In this paper the author examines what relations may exist between the chemical actions of electricity and the sign or tension of the electricity. He finds that ozone is formed equally under the influence of positive and of negative electricity. It is formed abundantly only under the influence of strong discharges. In operating upon mixtures of nitrogen and oxygen (both moist and dry) with the Holtz machine not the least trace of nitrous compounds has been observed, although a quantity smaller than 1-50th mgrm. could have been detected. Traces have been produced with the "effluve" of a Ruhmkorff apparatus. Acetylen is formed in notable amount in the vapours of organic compounds sealed up with nitrogen in tubes containing a metallic armature, and acted on by the discharges of the Holtz machine. The absorption of nitrogen by organic compounds is effected equally under the influence of both electricities.

Composition of Certain Phosphites.—A. Wurtz.—The phosphites in question are those of calcium and of barium (acid and neutral).

Modifications of Elæomargaric Acid Produced by Light and Heat.—M. S. Cloëz.—These observations on the modifications of elæomargaric acid explain in the most satisfactory manner the curious properties of the oil of *Elæococca*. This oil contains 75 per cent of elæomargarin, the remainder being ordinary olein. On saponification the elæomargaric acid yields solid elæomargaric acid and glycerin, whilst the olein furnishes oleic acid and glycerin. In the oil congealed under the influence of light, the liquid elæomargarin is changed into solid elæostearin, accompanied with a small quantity of liquid elæolin; the ordinary olein undergoes no change. Saponification yields elæostearic, elæolic, and oleic acids. Oil heated for a long time to 180° with the exclusion of air loses the power of becoming solidified under the action of light. This is because the elæomargarin is completely transformed into elæolin.

Note on a Method of Titrating Alkaline Sulphates.—M. F. Jean.—The quantitative determination of sulphuric acid combined with potassa and soda may be effected very rapidly and exactly by means of a simple alkalimetric titration. The aqueous solution of the substance in which the sulphuric acid combined with the fixed alkalies is mixed with a slight excess of baryta water, and then with Seltz water. The excess of baryta is precipitated in the state of baric carbonate, but as the carbonic acid would be able to dissolve this salt the liquid is decanted from the precipitate, which settles rapidly; it is raised to a boil and the whole is filtered. On account of the carbonate which envelopes the sulphate and acts like starch the filtration is effected very easily. The mixed precipitate having been washed with boiling-water until the washing waters no longer present an alkaline reaction, the filtrate is mixed with tincture of litmus, raised to a boil, and titrated with a standard solution of sulphuric acid. The quantity of sulphuric acid necessary to saturate the alkalies set at liberty by the baryta water is exactly the same as what was combined with the alkalies, potassa and soda, in the original matter. The titration of the alkaline sulphates may be effected by his process as rapidly as

the alkalimetry of a sample of carbonate of soda. On operating with dilute solutions, and under the conditions indicated above, the alkaline carbonates do not decompose the sulphates of baryta. This process may be advantageously applied to the titration of the salts of Stassfurt and of Bene, so much employed in agriculture. These salts, besides the alkaline sulphates, contain sulphates of lime, magnesia, &c., which render the determination of the alkaline sulphates by ordinary methods very tedious, and necessitate a complete analysis of these salts. By the method of titration which I point out these sulphates of lime, magnesia, &c., do not interfere, since these bases are precipitated by carbonic acid, whilst only the sulphates of potassa and soda enter into solution. This process is equally suitable for the assay of alkaline carbonates, but in this case care must be taken before treating the substance with baryta water to saturate the alkali with hydrochloric acid.

On the Saccharine Matter Contained in the Petals of Flowers.—M. J. Boussingault.—The author gives a list of flowers from the petals of which reductive sugar has been obtained. Others yield invertible sugar which has no action upon the cupric liquid until after the intervention of an acid.

On a Process for the Detection of Magenta in Wines.—M. Fordos.—The author takes 1 c.c. of the wine and agitates it briskly for some seconds with 1 c.c. of pure ammonia in a test-tube. He adds to the mixture 5 to 10 c.c. of chloroform and agitates again, closing the end of the tube with the thumb and inverting several times, and finally pours the whole into a glass funnel fitted with a tap. When the chloroform has collected at the bottom of the funnel he opens the tap and receives the chloroform in a capsule of porcelain, which is then placed on the sand-bath. A small piece of white silk is then steeped in the liquid and heat is applied. As the chloroform escapes, the magenta, if present, is fixed on the silk and dyes it a rose colour. Pure wine does not dye silk a rose colour. To prove that the colouration is due to magenta it is sufficient to put the swatch of silk into a little ammonia, when the rose colour at once disappears and returns if the ammonia is driven off by heat.

Note on the Detection of Rosolic Acid in Presence of Magenta (in Wines).—MM. P. Guyot and R. Bidaux.—Reserved for insertion in full.

On Crystals of Ferrous Oxide Presenting a Singular Deformation.—M. C. Friedel.—Not adapted for abstraction.

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EXPERIMENTAL CONTRIBUTIONS TO THE THEORY OF THE RADIOMETER.*

PRELIMINARY NOTICE.

By WILLIAM CROOKES, F.R.S., &c.

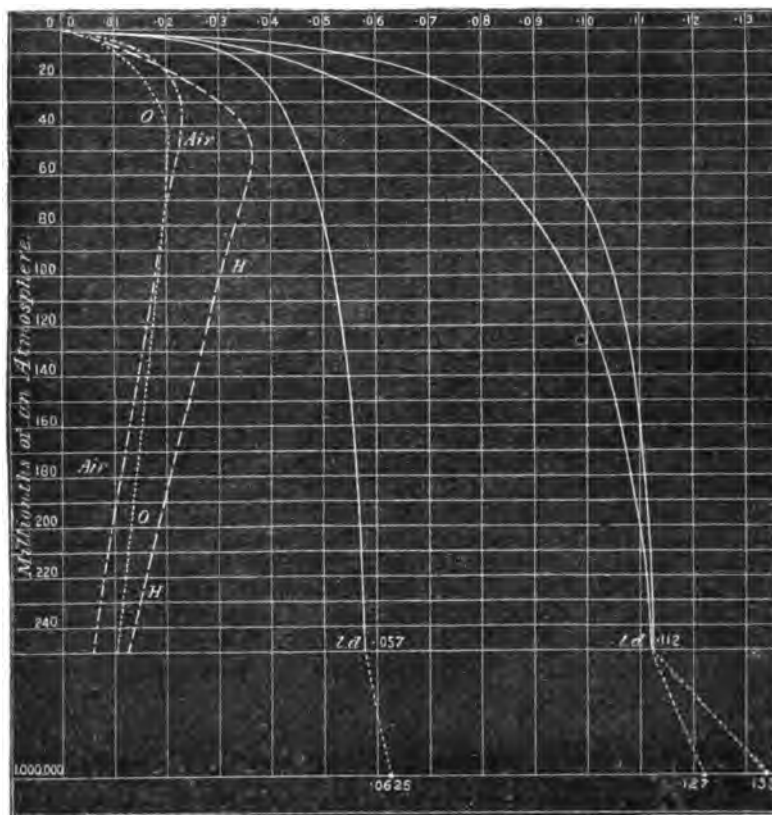
INSTEAD of bringing another preliminary notice before the Society, I should have preferred reserving the announcement of my new results on the Repulsion resulting from Radiation until they were fit to be offered in a more complete form; but the radiometer is now so much occupying the attention of scientific men, and results of experiments with this and allied instruments are appearing so frequently in the scientific journals at home and abroad, that were I not to adopt this method of bringing the results of my more recent experiments before men of science, I might find myself anticipated in some or all of the conclusions at which I have arrived.

the mercury pump I have been able to measure the atmospheric pressure at any desired stage of exhaustion. I have not only measured the force of repulsion, but also the viscosity of the residual gas, and from the results plotted I have the observations in curves which accompany this paper, and which show how the viscosity of the residual gas is related to the force of repulsion exerted by radiation. These curves must not, however, be considered as representing more than the broad facts, for I have not included in them my final observations, which in all probability will introduce modifications in them.

In plotting these curves I have supposed my scale to be 1000 metres long, and to represent one atmosphere. Half-way up the scale therefore, or 500 metres, represents half an atmosphere; 999 metres up the scale represents an exhaustion of 1-1000th of an atmosphere; each millimetre, therefore, stands for the millionth of an atmosphere.

My results have principally been obtained at the top of the scale, and it is the last quarter of a metre which supplies the diagrams accompanying this paper.

When the residual gas is air, the viscosity (measured by the logarithmic decrement of the arc of oscillation) is practically constant up to an exhaustion of 250 millionths of an atmosphere, or 0.19 millim. of mercury, having only diminished from 0.126 at the normal pressure of the atmosphere, to 0.112. It now begins to fall off: at 200 millionths



On June 15th last I mentioned to the Society that the repulsion resulting from radiation increases up to a certain point as I exhaust the air from the torsion apparatus. After long-continued exhaustion the force of radiation approaches a maximum, and then begins to fall off. I have since succeeded in experimenting at still higher exhaustions, and with different gases in the apparatus; and by means of a McLeod gauge attached to

it is 0.110; at 100 millionths it is 0.096; at 50 millionths it is 0.078; at 20 millionths it is 0.052; at 10 millionths it is 0.035; and at 0.1 of a millionth of an atmosphere, the log. dec. has fallen to about 0.01. Simultaneously with this decrease in the viscosity, the force of repulsion exerted on a black surface by a standard light varies. It increases very slowly till the exhaustion has risen to about 70 millionths of an atmosphere; at about 40 millionths it is at its maximum; and it then sinks very rapidly: 0.1 millionth of an atmosphere it is less than on

* A Paper read before the Royal Society, November 16, 1876.

its maximum. On continuing the curves of the log. dec. and the force of radiation, and assuming that the torsion fibre of glass has no viscosity, it is most probable that they both would come to zero when the last traces of an atmosphere had been taken out of the apparatus.

The oxygen diagram differs from that of air. The log. dec. is 0.126 at the atmospheric pressure; it falls to 0.111 at a pressure of 250 millionths of an atmosphere; at 100 millionths it is 0.105; at 50 millionths it is 0.093; at 20 millionths it is 0.068; and at 2 millionths it is 0.02. The force of repulsion in oxygen increases very steadily up to an exhaustion of about 40 millionths of an atmosphere; it is at its maximum at about 30 millionths, and thence declines very rapidly.

Hydrogen gives a remarkable diagram. The viscosity at the normal pressure is measured by a log. dec. of 0.063; at 250 millionths of an atmosphere it is 0.057; at 100 millionths it is 0.052; at 50 millionths it is 0.046, whence it rapidly sinks. The force of repulsion increases slowly up to an exhaustion of 250 millionths, then quickly until it attains its maximum at about 50 millionths, and it then rapidly sinks. The force of repulsion is very great in a hydrogen vacuum, being in comparison with the maximum in an air vacuum as 70 to 41. Neither is it necessary to get so high an exhaustion with hydrogen as with other gases to obtain considerable repulsion. This shows that in the construction of radiometers it is advantageous to fill them with hydrogen before exhausting.

Carbonic acid has a viscosity of about 0.01 at the normal pressure, being between air and hydrogen, but nearer the former. On approaching a vacuum the force of repulsion does not rise very high, and soon falls off.

Before working with this apparatus I thought that monohydrated sulphuric acid evolved no vapour, and I therefore freely used it for cleaning out the pump and for drying the gases. I can even now detect no vapour tension, but a comparison of the curves, with and without sulphuric acid, shows that the presence of this body modifies the results. One of my curves represents the action of the residual sulphuric anhydride gas. The experience thus gained has led me to adopt phosphoric anhydride for drying the gases. I can detect no ill effects from the presence of this agent, and I have been able in consequence to push the rarefaction to higher points than before.

The McLeod gauge will not show the presence of mercury vapour. It is therefore possible that I have a greater pressure in the apparatus than is here stated. I have, however, entirely failed to detect the presence of mercury vapour at any great distance from the mercury in the pump; and the tube packed with gold-leaf, which I frequently interpose between the pump and the apparatus, shows no trace of bleaching, and exerts no appreciable effect one way or the other on the results.

With this pump, assisted sometimes by chemical absorption, it is not difficult to exhaust a radiometer to such a point that it will not move to a candle placed a few inches off; but I have not yet succeeded in stopping the movement of the beam in the torsion apparatus.

A long series of observations have been taken, at different degrees of exhaustion, on the conductivity of the residual gas, to the spark from an induction coil. Working with air, I find that at a pressure of about 40 millionths of an atmosphere, when the repulsive force is near its maximum, a spark, whose striking distance at the normal pressure is half an inch, will illuminate a tube having aluminium terminals 3 millimetres apart. When I push the exhaustion further, the $\frac{3}{4}$ -inch spark ceases to pass; but a 1 inch spark will still illuminate the tube. As I get nearer to a vacuum more power is required to drive the spark through the tube, but at the highest exhaustions I can still get indications of conductivity when an induction coil, actuated with five Grove's cells, and capable of giving a 6-inch spark, is used.

When so powerful a spark is employed there is great danger of perforating the glass, thus causing a very slight leakage of air into the apparatus. The log. dec. now slowly

risks, the repulsive force of the candle increases to its maximum, and then slowly diminishes to zero, the log. dec. continuing to rise till it shows that the internal and external pressure are identical. With a fine perforation several days are occupied in going through these phases, and they take place with such slowness and regularity as to afford opportunities for getting valuable observations.

The improvements now added by Mr. Gimmingham to the pump render it so easy to obtain high exhaustions that, in preparing experimental radiometers, I prefer to exhaust direct to one or two millionths of an atmosphere. By keeping the apparatus during this exhaustion in a hot air-bath heated to about 300° C. for some hours, the occluded gases are driven off from the interior surface of the glass and the fly of the radiometer. The whole is then allowed to cool, and attenuated air from the air trap is put in in small quantities at a time, until the McLeod gauge shows that the best exhaustion for sensitiveness is reached; if necessary this point is also ascertained by testing with a candle. Working in this way I can now do in a few hours what formerly required as many days. In this manner, employing hydrogen instead of air for the gaseous residue, and using roasted mica vanes set at an angle with the axis, as described further on, I can get very considerably increased sensitiveness in radiometers. I am still unable, however, to get them to move in moonlight. The statements made by an observer nearly a year ago, that he obtained strong rotation by moonlight, must therefore be considered as erroneous. My most sensitive torsion balance will, however, move easily to moonlight.

The above-mentioned facts, in addition to what has already been published, leave no reasonable doubt that the presence of residual gas* is the cause of the movement of the radiometer. But few theories are sufficiently strong not to require reinforcement, and in the present case very much remains to be ascertained as regards the mode of action of the residual gas. The explanation, as given by Mr. Johnstone Stoney, appears to me the most probable, and having stood almost every experimental test to which I have submitted it, I may assume for the present that it expresses the truth. According to this the repulsion is due to the internal movements of the molecules of the residual gas. When the mean length of path between successive collisions of the molecules is small compared with the dimensions of the vessel, the molecules, rebounding from the heated surface, and therefore moving with an extra velocity, help to keep back the more slowly moving molecules which are advancing towards the heated surface; it thus happens that though the individual kicks against the heated surface are increased in strength in consequence of the heating, yet the number of molecules struck is diminished in the same proportion, so that there is equilibrium on the two sides of the disk, even though the temperatures of the faces are unequal. But when the exhaustion is carried to so high a point that the molecules are sufficiently few, and the mean length of path between their successive collisions is comparable with the dimensions of the vessel, the swiftly moving, rebounding molecules spend their force, in part or in whole, on the sides of the vessel; and the onward crowding, more slowly moving molecules are not kept back as before, so that the number which strike the warmer face approaches to, and in the limit equals, the number which strike the back, cooler face; and as the individual impacts are stronger on the warmer than on the cooler face, pressure is produced, causing the warmer face to retreat.

I have tried many experiments with the view of putting this theory to a decisive test. The repulsive force being due to a reaction between the fly and the glass case of a

* It is a question whether the residual gas in the apparatus, when so highly attenuated as to have lost the greater part of its viscosity, and to be capable of acquiring molecular movement palpable enough to overcome the inertia of a plate of metal, should not be considered to have got beyond the gaseous state, and to have assumed a fourth state of matter, in which its properties are as far removed from those of a gas as this is from a liquid.

radiometer, it follows that, other things being equal, the fly should revolve faster in a small bulb than in a large one. This cannot well be tested with two different radiometers, as the weight of the fly and the amount of friction would not be the same in each, but I have constructed a double radiometer which shows this fact in a very satisfactory manner. It consists of two bulbs, one large and the other small, blown together so as to have a wide passage between them. In the centre of each bulb is a cup, held in its place by a glass rod, and in the bulbs is a small four-armed fly with roasted mica disks blacked on one side. The fly can be balanced on either cup. In the smaller bulb there is about a quarter of an inch between the vanes and the glass, whilst in the larger cup there is a space of half an inch. The mean of several experiments shows that in the small bulb the fly rotates about 50 per cent faster than in the large bulb, when exposed to the same source of light.

One of the arms of another radiometer was furnished with roasted mica disks blacked on alternate sides. The other arm was furnished with clear mica disks. The two arms were pivoted independently of each other, and one of them was furnished with a minute fragment of iron, so that by means of a magnet I could bring the arms in contact, the black surface of the mica then having a clear plate of mica in front of it. On bringing a lighted candle near the instrument, and allowing it to shine through the clear plate, on the blackened mica, the clear plate is at once driven away, till the arm sets at right angles to the other.

Two currents of force, acting in opposite directions, can exist in the same bulb. I have prepared a double radiometer in which two flies are pivoted one over the other, and having their blackened sides turned in opposite directions. On bringing a lighted candle near, the flies rapidly rotate in opposite directions.

Experiment shows that the force can be reflected from a plane surface in such a manner as to change its direction. If an ordinary radiometer is exposed to light the black surface is repelled, owing to the excess of pressure acting between it and the glass. If, however, a plate of mica were to arrest this force and reflect it back again, the motion should be reversed. Experiment shows that this is the case. A two disk radiometer was made, having flat opaque mica disks blacked on one side. In front of the black surface of the mica and about a millimetre off, is fixed a large disk of thin clear mica. On bringing a candle near, the molecular pressure streaming from the black surface is caught by the clear plate and thrown back again, causing pressure behind instead of in front, and the result is rapid rotation in the negative direction, the black side now moving towards the light.

To still further test this view of the action I made another radiometer, similar to the above, but having a clear mica disk on each side of the ordinary mica vane. This prevents the reflection of the pressure backwards, and causes it to expend itself in a vertical plane, the result being an almost total loss of sensitiveness.

The above actions can be explained on the "evaporation and condensation" theory, as well as by that of molecular movement, and I therefore devised the following test to decide between these two theories:—A radiometer has its four disks cut out of very clear and thin plates of mica, and these are mounted in a somewhat large bulb. At the side of the bulb, in a vertical plane, a plate of mica, blacked on one side, is fastened in such a position that each clear vane in rotating shall pass it, leaving a space between of about a millimetre. If a candle is brought near, and by means of a shade the light is allowed to fall only on the clear vanes, no motion is produced; but if the light shines on the black plate the fly instantly rotates as if a wind were issuing from this surface, and keeps on moving as long as the light is near. This could not happen on the evaporation and condensation theory, as this requires that the light should shine intermittently on the black surface in order to keep up continuous movement.

By cutting a thin plate of aluminium into the form of a

spiral, then drawing it out corkscrew fashion, blacking the upper surface and suspending it on a point, a spiral radiometer is made, which rotates like a screw on exposure to light. Here also the black surface need never be in darkness, the pressure acting continuously between the black side of the spiral and the cylindrical tube in which it is mounted.

The experiments with the double radiometer of different sizes showed that the nearer the absorbing surface was to the glass, the greater was the pressure produced. To test this point in a more accurate manner, a torsion balance was fitted up with a glass suspending fibre and reflecting mirror, as described in my previous papers. At one end of the beam is a disk of roasted mica blacked on one side. In front of this black surface, and parallel to it, is a plate of clear mica, so arranged that its distance from the black surface can be altered as desired, at any degree of exhaustion, without interfering with the vacuum. This apparatus is very sensitive, and gives good quantitative results. It has proved that when light falls on the black surface molecular pressure is set up, whatever be the degree of exhaustion. At the atmospheric pressure this disturbance can only be detected when the mica screen is brought close to the black surface, and it is inappreciable when the screen is moved away. As the barometer gauge rises the thickness of the layer of disturbance increases. Thus, retaining the standard candle always the same distance off, when the gauge is at 660 millims., the molecular pressure is represented by 1, when the space separating the screen from the black surface is 3 millims.; by 3 when the intervening space is reduced to 2 millims.; and by 5 when the space is 1 millim. With the gauge 722 millims. high, the values of the molecular pressure for the spaces of 3, 2, and 1 millims. are respectively 3, 7, and 12. When the gauge is at 740 millims. the corresponding values for spaces of 3, 2, and 1 millim. are 11, 16, and 23. With the gauge at 745 millims. the molecular pressures are represented by 30, 34, and 40, for spaces 3, 2, and 1 millims. When the gauge and barometer are level, the action is so strong that the candle has to be moved double the distance off, and the pressures when the intervening spaces are 12, 6, and 3 millims. are respectively 60, 86, and 107. A large series of observations have been taken with this apparatus, with the result not only of supplying important data for future consideration, but of clearing up many anomalies which were noticed, and of correcting many errors into which I was led at earlier stages of this research. Among the latter may be mentioned the speculations in which I indulged as to the pressure of sunlight on the earth.

Hitherto most of my experiments had been carried on with bad conductors of heat. To get the maximum action of a radiometer it appeared necessary that no heat should pass through to the back surface, but that all should be kept as much as possible on the surface on which the light fell.* At first I used pith, but since learning the advantage of raising the whole apparatus to a high temperature during exhaustion, I have used roasted mica lampblack on one side for the vanes; for this purpose it is almost perfect; being a good absorber on one face, a good reflector on the other, a bad conductor for heat, extremely light, and able to stand high temperatures. Many experiments have been tried with metal radiometers, some of the results being recorded in previous papers which I have read before the Society, but being less sensitive than pith or mica instruments, I had not hitherto worked much with them. I now tried similar experiments to the above, using the best conductors of heat instead of the worst; and for this purpose thick gold-leaf was selected for the surface on which to try the action of radiation.

An apparatus was constructed resembling a radiometer

* I have already shown that when a ray of light from any part of the spectrum falls on a black surface the ray is absorbed and degraded in refrangibility, warming the black surface, and being emitted as radiant heat. In this sense only can the repulsion resulting from radiation be called an effect of heat.

with an opening at the top, capable of being closed with a plate of glass. Through this I could introduce disks of any substance I liked, mounted in pairs on an aluminium arm rotating on a needle point. The first disks were of gold-leaf, blacked on alternate sides. After exhaustion, a candle repelled the black surface of one of the disks, but to my surprise it strongly attracted the black surface of the other disk. I noticed that the disk which moved the negative way was somewhat crumpled, and had the outer edge curved so as to present a slightly concave black surface to the candle. I soon found that the curvature of the disk was the cause of the anomaly observed, and experiments were then tried with disks of gold and aluminium; the latter being chiefly used as being lighter and stiffer, whilst it acted in other respects as gold.

A radiometer, the fly of which is made of perfectly flat aluminium plates lamblackened on one side, is much less sensitive to light than one of mica or pith, but, as I proved in my earlier papers, it is more sensitive to dark heat. Exposed to light, the black face of a metal radiometer moves away as if it were black pith. When, however, it is exposed to dark heat, either by grasping the bulb with the warm hand, dipping it into hot water, or covering it with a hot glass shade, it rapidly rotates in a negative direction, the black advancing, and continuing to do so until the temperature has become uniform throughout. On now removing the source of heat, the fly commences to revolve with rapidity the positive way, the black this time retreating as it would if light shone on it. Pith or mica radiometers act differently to this, dark heat causing them to revolve in the same direction as light does.

The outer corners of the aluminium plates, which were mounted diamond-wise, were now turned up at an angle of 45° , the lamblackened surface being concave and the bright convex. On being exposed to a candle, scarcely any movement was produced; when one vane was shaded off the other was repelled slightly, but the turned up corner seemed to have almost entirely neutralised the action of the black surface. A greater amount of the same corner was now turned up, the fold going through the centres of adjacent sides. Decided rotation was now produced by a candle, but the black surface was *attracted** instead of repelled. Dark heat still caused the opposite rotation to light, repelling the black surface.

The plates were now folded across the vertical diagonal, the black surface being still inside, and the bright metal outside. The actions with a candle and hot glass shade were similar to the last, but more decided.

The plates were now flattened, and put on the arms at an angle, still being in the vertical plane. When the bright surface was outside, scarcely any action was produced by a candle, but when the lamblackened surface was outside strong repulsion of the black was produced, both with a candle and with a hot shade.

Two square aluminium plates were mounted in the experimental apparatus, one being attached to the arm by the centre of one of the sides, and the other by an angle. The opposite corner of the one mounted diamond-wise was turned up at an angle. The outer convex surface of the diamond plate was blacked, and the side of the square plate facing the same way was also blacked, so that either two black or two bright surfaces were always exposed to the light, instead of a black and a white surface, as is usual in radiometers. As might have been expected both these black surfaces were repelled, but the turned up corner of the diamond-mounted plate proved so powerful an auxiliary to its black surface, that strong rotation was kept up, the square plate being dragged round against the action of light.

Folding the plates with the angle horizontal has not so decided an action as when the fold is vertical.

Sloping the plates and disks of a lamblackened mica radiometer so as to have the black outside, and conse-

quently more facing the side of the bulb, greatly increases its sensitiveness.

The above experiments show that shape has even a stronger influence than colour. A convex bright surface is strongly repelled, whilst a concave black surface is not only not repelled by radiation but is actually attracted.

I have also tried carefully shaped cups of gold, aluminium, and other metals, as well as cones of the same materials. I will briefly describe the behaviour of a few typical radiometers made with metal cups, which I have the honour of exhibiting to the Society.

No. 1035. A two-disk, cup-shaped radiometer, facing opposite ways; both sides bright. The disks are 14.5 millims. diameter, and their radius of curvature is 14 millims.

Exposed to a standard candle 3.5 inches off, the fly rotates continuously at the rate of one revolution in 3.37 seconds. A screen placed in front of the concave side so as to let the light shine only on the convex surface, repels the latter, causing continuous rotation at the rate of one revolution in 7.5 seconds. When the convex side is screened off, so as to let the light shine only on the concave side, continuous rotation is produced at the rate of one revolution in 6.95 seconds, the concave side being attracted.

These experiments show that the repulsive action of radiation on the convex side is about equal to the attractive action of radiation on the concave side, and that the double speed with which the fly moves when no screen is interposed is the sum of the attractive and repulsive actions.

No. 1037. A two-disk, cup-shaped aluminium radiometer as above, lamblackened on the concave surfaces.

In this instrument the action of light is reversed, rotation taking place, the bright convex side being repelled, and the black concave attracted.

That this attraction is not apparent only, is proved by shading off the sides one after the other. When the light shines only on the bright convex side, no movement is produced, but when it shines on the black concave side, this is attracted, producing rotation.

No. 1038. A cup-shaped radiometer similar to the above, but having the convex surfaces black and the concave bright.

Light shining on this instrument causes it to rotate rapidly, the convex black being repelled. No movement is produced on letting the light shine on the bright concave surface, but good rotation is produced when only the black convex surface is illuminated.

No. 1039. A cup-shaped radiometer like the above, but blacked on both sides.

With this a candle causes rapid rotation, the convex side being repelled. On shading off the light from the concave side the rotation continues, but much more slowly; on shading off the convex side the concave is strongly attracted, causing rotation.

When either of these four radiometers is heated by a hot shade or plunged into hot water, rotation is always produced in the opposite direction to that caused by the light. On removing the source of heat, the motion rapidly stops, and then commences in the opposite direction (*i.e.*, as it would rotate under the influence of light), the rotation continuing as long as the fly is cooling. Chilling one of these radiometers with ether has the opposite action to exposing it to dark heat.

The vanes of radiometers have also been formed of metal cones, and of cups and cones of plain mica, roasted mica, pith, paper, &c.; and they have been used either plain or blacked on one or both surfaces. These have also been balanced against each other, and against metal plates and cones. The results are of considerable interest, but too complicated to explain without great expenditure of time and numerous diagrams. The broad facts are contained in the above selections from my experiments.

The action of light on the cup-shaped vanes of a radio-

* I use the word attraction in these cases for convenience of expression. I have no doubt that what looks like attraction in these and other cases is really due to a *vis a tergo*.

meter probably requires more experimental investigation before it can be properly understood. Some of the phenomena may be explained on the assumption that the molecular pressure acts chiefly in a direction normal to the surface of the vanes. A convex surface would therefore cause greater pressure to be exerted between itself and the bounding surface of glass than would a concave surface. In this way the behaviour of the cup-shaped radiometer with both bright surfaces, No. 1035, can be understood, and perhaps also that of Nos. 1038 and 1039. It would not be difficult to test this view experimentally, by placing a small mica screen in the focus of a concave cup where the molecular force should be concentrated. But it is not easy to see how such an hypothesis can explain the behaviour of No. 1037, where the action of the bright convex surface more than overcomes the superior absorptive and radiating power of the concave black surface; and the explanation entirely fails to account for the powerful attraction which a lighted candle is seen to exert on the concave surfaces in Nos. 1035, 1037, and 1039.

NEW TESTS FOR ANTHRACEN.

By JOSEPH BENNETT BROS.

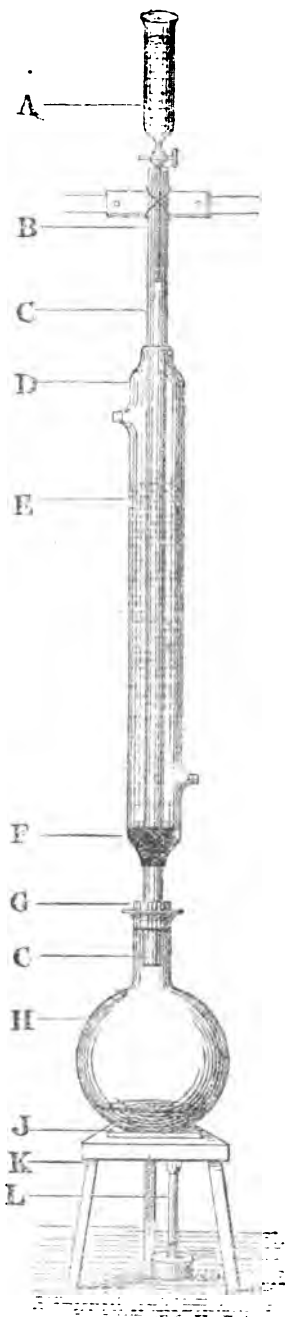
THE following is a new test for the determination of pure anthracen, and also a more detailed account of the process by which the tar distillers may get a fair idea of the quality of their anthracen before it is sampled and tested by the analyst. This will save them the trouble at times of having the goods disputed on the point of quality.

In the rough sketch herewith, A is the tap-funnel containing the oxidising mixture, which drops through the half-inch pipe c, pass d condenser (containing cold water, to e) into flask H. F is india-rubber joint to prevent the water in condenser escaping; B is wire and support to apparatus; G, cork; J, wire gauze; K, stand; and L is Bunsen burner. Apparatus without stand, about 4 feet high; condenser about 2 inches diameter.

No. 1.—The oxidising solution is made by dissolving 100 grms. of chromic acid in 50 c.c. of glacial acetic acid and 50 c.c. of water. The whole is kept standing to allow the impurities to precipitate. 1 grm. of anthracen is placed in a flask fitted with a condenser, 45 c.c. of glacial acid is added, the whole is heated to gentle boil; 21 c.c. of the oxidising mixture (about 15 grms. chromic acid) is now added by degrees, and the boiling continued until finished, as in the anthraquinon test. The quinon is then precipitated and washed in the usual way. It is now washed into a dish, and dried on a water-bath. The dry residue is treated with ten times its weight of concentrated sulphuric acid (about 1.84 sp. gr.), heated on a water-bath for one hour, or until it becomes a crystalline mass by absorbing water. It is then diluted with 100 c.c. of water, thrown on a counterpoised filter, and washed, first with water, then with a 1 per cent boiling solution of caustic potash, finally with water, dried, and weighed. From the weight of quinon thus obtained subtract the ash remaining after incineration, and calculate, with the allowance, into pure anthracen by the ordinary method.

It must be well understood that this test should only be used when the chosen analyst's decision is final for percentage for value.

No. 2.—Place 1 grm. of anthracen in the glass flask, H, which will hold about 500 c.c. (through the cork of which a glass pipe with a glass condenser is fitted), add 45 c.c. glacial acetic acid; now fix in the cork with pipe and condenser, and gently boil; place in the other end of the pipe above the condenser a glass tap-funnel. Pour into the funnel 21 c.c. of the chromic acid mixture (which should contain about 15 grms. chromic acid), keep flask at gentle boiling heat, and by turning on the tap of the funnel let a few drops of the chromic acid mixture fall at in-



tervals into the flask H, occupying about two hours in adding all: the liquid must then be boiled fully two hours longer; the heat is then shut off, and the flask with its contents allowed to stand about twelve hours in the cold. The cork with pipe and condenser is then removed, and about 400 c.c. of cold water are mixed with the contents of the flask; it is then allowed to stand for about three hours longer. The liquid is now filtered, the precipitated anthraquinon collected on the filter, washed with cold water, then with 1 per cent boiling solution of caustic potash, finally with pure hot water. The quinon is now

washed from the filter into a dish, and evaporated to dryness on a water-bath. The dry residue is now dissolved in ten times its weight of concentrated sulphuric acid (about 1·84 sp. gr.), and heated on a water-bath for one hour until it becomes a crystalline mass by absorbing water. It is now diluted with 100 c.c. of water, thrown on a counterpoised filter, washed, first with water, then with a 1 per cent boiling solution of caustic potash, finally with pure hot water, then dried, and weighed. The anthraquinon is now volatilised from a platinum crucible, and the weight of ash remaining deducted.

As a check two tests should be made at the same time, requiring, of course, another apparatus.

The anthraquinon is calculated into pure anthracen by multiplying the net weight of anthraquinon by 0·856; as, for example,—

Anthraquinon	36·050 grm.
Multiplied by	0·856 „
Gives pure anthracen, about ..	30·860 „

The allowances for ash, &c., should be left to the analyst, but this is only a small matter.

22 and 23, Great Tower Street, London,
December 11, 1876.

DESCRIPTION OF A NEW GAS-BOTTLE AND ARRANGEMENTS OF APPARATUS FOR APPLYING SULPHURETTED HYDROGEN WITHOUT SMELL, AND AVOIDING ITS ESCAPE.

By WILLIAM GRIFFIN, F.C.S.

It often occurs that the study of chemistry has been prevented in consequence of the disagreeable and noxious vapours of sulphuretted hydrogen, which is one of the chief reagents employed in the ordinary course of analysis. Few private houses contain rooms which can be furnished with the regular fittings of the laboratory, including the expensive chamber for conveying away noxious fumes. In order to obviate this difficulty I have devised the following apparatus:—

A gas bottle, consisting of three glass bulbs, one somewhat larger than the other two; these bulbs are connected by necks of about a quarter of an inch internal diameter. The larger bulb is furnished with a neck, tightly closed with an india-rubber plug, and the centre bulb is fitted with a stopcock.



To charge this gas-bottle it is necessary to fill the small bulb with diluted sulphuric acid; about one part of acid to five parts of water will be found a convenient strength. If the acid be either too strong or too weak the evolution of the gas is hindered. A piece or so of sound sulphide of iron, previously washed to remove powder and small pieces which might fall through the necks, is then placed in the large bulb, and to produce the gas the bottle is reversed, so as to cause the acid to flow from the small bulb into the large one containing the sulphide of iron which will then have the neck containing the rubber plu

downwards, and be hermetically sealed by the layer of liquid above it.

When reversing the bottle it is necessary to avoid allowing the acid to run into the glass tap connected with the centre bulb. The production of gas can be stopped by restoring the bottle to its original position, which will cause the acid to flow away from the sulphide of iron.

It will be found convenient to fix the bottle by a piece of copper wire twisted round its necks, and fastened in a cork to some stand or support, upon which it may be easily reversed.

The gas-bottle is connected by rubber tubing with a cork, preferably a rubber one, containing two glass tubes, and fitting into the mouth of a very stout test-tube, about 7 inches in length and 1 in diameter. It is necessary that the test-tube should be stout, or it will be liable to break upon corking and uncorking, and it is advisable to procure several which will fit the cork bearing the gas delivery-tubes, one of which, connected by the india-rubber tube with the gas-bottle, passes to the bottom of the test-tube, and serves to convey the sulphuretted hydrogen through the liquid to be tested, and the other just penetrates the cork, and is also attached to a rubber tube, which conveys the excess of gas to the receiver in which it is to be absorbed. The test-tube is loosely fitted by means of a bung into a jar which contains hot water, as the precipitates formed by sulphuretted hydrogen are produced most favourably when the liquid assayed is kept warm. This jar also serves as a stand for the test-tube, and prevents its being upset by the twist of the india-rubber tubes. Small flasks can be used instead of the test-tubes, but, on the whole, the latter are preferable, not being so liable to upset.

The absorber consists of an upright cylinder on a foot, with a neck near the base, usually called upright chloride of calcium jar, and is connected with the second glass tube in the cork of the test-tube. This cylinder is filled with sawdust mixed with coarsely powdered sugar of lead, and it is as well if before being used it is moistened with a saturated solution of sugar of lead. The top of the cylinder is loosely closed with a cork. When not in use it may be corked up at top and at the neck at the foot. A small brush, such as is ordinarily used for cleaning tobacco pipes, will be found useful for cleaning the glass tube which leads the sulphuretted hydrogen into the test-tube, and it is convenient to have several pieces of such tubing of equal length and diameter.

When sufficient gas has been passed through an assay the gas-bottle is reversed, the tap turned off, and the rubber tube disconnected from the glass tap. A piece of the glass tubes mentioned above can then be slipped into the end of the rubber tubing, and the remnant of the gas above the assay in the test-tube blown into the absorption-cylinder.

Digestions with sulphide of ammonium can be made with the test-tube and the absorption cylinder alone.

The gas-bottle, for cheapness, can be made without the glass stopcock; in which case the rubber tube between it and the test-tube should be of two portions connected over a piece of glass tubing. When an operation is over, and the gas-bottle reversed, the piece attached to the bottle is slipped off the connecting glass tubing, and its orifice is closed with a piece of solid glass rod or a pinchtap.

German Chemical Society.—At the annual meeting of the German Chemical Society, held at Berlin Dec. 22, the following officers were elected for the year 1877:—President, Prof. F. Wöhler; Vice-Presidents, Profs. Kekulé, Baeyer, Hofmann, and Liebermann. The retiring President (Prof. Hofmann) stated in his annual report that the present number of members was 1598, showing an increase of 225, during the past year, and that 423 original scientific communications had been presented before the Society during this time twelve months. The *Berichte* for 1876 form a volume of about 1900 pages.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 21st, 1876.

Professor ABEL, F.R.S., President, in the Chair.

AFTER the minutes of the preceeding meeting had been read and confirmed the names of Messrs. A. Gaved Phillips and F. Kopfer were read for the first time. The President read a letter from the Secretary of the Royal Society as to the nature and conditions under which grants would be made from the £4000 given by Government in aid of original research.

The first paper, entitled "*A further Study of Fluid Cavities*," was read by Mr. W. N. HARTLEY, and the results of his examination of a large number of topazes selected from the magnificent collection in the British Museum showed that the cavities scarcely ever contained anything but water. If the view be accepted that topaz has been formed by the action of alkaline fluorides or cryolite on kaolin no carbon dioxide would be liberated, so that it might not necessarily be found in the fluid cavities. This is corroborated by the fact that in one and the same topaz cavities may exist side by side, one of which is nearly filled with liquid carbon dioxide, the other one-third with water, one-third with liquid, and one-third with gaseous carbon dioxide, the space occupied by the gaseous CO₂ having been produced by the contraction of the water on cooling. He inferred, moreover, that the critical temperature of water had not been reached, otherwise the contents of the adjacent cavities would have been uniform.

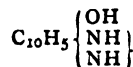
The author has also examined a very large number of rock sections, principally granites and porphyries, almost all of which contained water cavities, but in none of them was the presence of carbon dioxide distinctly proved. A curious phenomenon in connection with the bubbles in the water cavities of rock crystal was sometimes observed, namely, that when heated the bubble became more dense than the liquid, and sank; so that in large deep cavities they went entirely out of focus when observed with a half-inch objective. In one specimen of quartz it was found that the bubble began to sink at 150° C., but not before it had reached this temperature. The cause of this motion appears to be that the bubble consists of a gas so highly compressed that it is nearly of the same density as water at the ordinary temperature. On heating, the water expands, thus still further condensing the gas in the cavity, which then becomes heavier than the liquid and consequently sinks in it. It is very remarkable that the cavities are not only frequently arranged symmetrically around the axis of the crystal, but in some cases they take the form of the crystals in which they are enclosed, each side of the cavity being parallel to a face of the crystal. Drawings of sections of crystals were exhibited in which this was very clearly shown. This is probably caused by the water exerting a resistance to compression comparable to a solid body at the high temperature at which the crystal was formed, but being mobile the shape of the enclosed water was altered so as to conform to the planes of crystallisation of the mineral as the silica molecules grouped themselves around it.

The PRESIDENT, in thanking the author, remarked that this investigation in his hands had been prolific in interesting results. He hoped that his ingenious speculations, bearing on the formation of these crystalline substances and the cavities contained in them, would give rise to a valuable discussion.

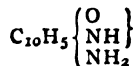
In reply to a question put by Dr. ARMSTRONG with reference to the occlusion of hydrogen by trap rocks, recently investigated by an American chemist, Mr. HARTLEY said that in samples of trap from the neighbourhood of Edinburgh, which he had examined, he had

noticed cavities, but they contained nothing; cavities containing liquefied carbon dioxide had been observed, however, in trap. He had not considered the question as to whether such cavities contained hydrogen, his attention having been chiefly confined to quartz, granites, porphyries, &c., as most likely to have cavities containing liquefied carbon dioxide, the special object of his search.

Dr. H. E. ARMSTRONG then gave a paper "*On Thymo-quinon*." In a recent communication to the Berlin Chemical Society, Liebermann pointed out that the "oximido-naphthol,"



of Graebe and Ludwig, prepared by the oxidation of diamido-naphthol, is more probably a compound of the formula—



and that when it is oxidised to naphtha-quinon, the NH₂ group is displaced by OH; in other words, the OH group and one of the NH₂ groups in diamido-naphthol are concerned in the formation of the quinon, and not both the NH₂ groups as Graebe and Ludwig supposed. It is to be presumed, therefore, that in the formation of oxythymo-quinon from diamido-thymol (recently effected by Carstanjen) by oxidation, a similar reaction takes place, namely, that only one of the NH₂ groups and the OH group are concerned in the production of this quinon, the other NH₂ group being merely replaced by hydroxyl. Carstanjen has also obtained the same oxythymo-quinon by treating the monobromo derivative of thymo-quinon with potassic hydrate. Ladenburg has employed these results as the basis of a speculative theory as to the value of the several hydrogen atoms in benzene, in which he makes the perfectly gratuitous and unsupported assumption that in the first instance the thymol OH group remains unaffected, only the two amido groups taking part in the formation of the quinon; whilst in the second instance the thymol OH group does take part in the formation of the quinon. This, Liebermann points out, is not only unproved but is improbable. Dr. Armstrong stated that for a long time he had been engaged in an investigation of thymol and its derivatives, and had already obtained results which show that Ladenburg's assumption was incorrect, even if it had not been contrary to our knowledge of the law governing substitution in the phenol derivatives that para and ortho compounds are first formed. The author had found that monamido-thymol from nitroso-thymol, in which the NH₂ group occupies the para-position relatively to the OH group, yielded thymo-quinon when distilled with ferric chloride equal in weight to more than half the weight of the thymol employed in the preparation of the nitroso-derivative. He also stated that the formula suggested by Liebermann for "oximido-naphthol," &c., had already been suggested by Mr. C. E. Groves and himself in a foot-note in the new edition of Miller's "*Organic Chemistry*" they are now preparing, the proof sheet containing the note being handed in to the President.

The PRESIDENT having thanked the author for his communication,

A paper "*On High Melting-Points with Special Reference to those of Metallic Salts* (Part II.)," by Dr. T. Carnelley, was read. The method to be employed depends on the principle that if three salts, A, B, and C, whose fusion points are in the order A, B, C, be arranged on a cold block of iron, and then introduced into a muffle kept at a constant high temperature the ratio $\frac{\gamma}{x}$ is approximately constant for the same three salts, whatever the temperature of the muffle; x being the number of seconds which elapse between the melting of A and B, and y that between the melting of B and C. The arrangement of the muffle

and iron blocks is shown in an engraving, and the methods of working given in detail. The results of a large number of experiments instituted to prove that the law just enunciated holds good under varying circumstances is given in a series of tables. The author proposes in a future communication to show how this principle may be employed in the actual determination of high melting-points.

The SECRETARY then gave an outline of a paper "*On the Estimation of Urea*," by Mr. G. TURNER, containing the results of his experiments in determining urea by Russell and West's method, the apparatus employed being a modification of that known as "Schiebler's calcimeter."

Dr. G. BISCHOF read a short notice "*On the Corrosion of Lead by the New River Company's Water*," saying that he had observed the formation of a crust of lead carbonate on the exterior of a piece of gas tube which had been employed as a syphon in a cistern supplied by the New River Company, and which was constantly alternately exposed to the action of air and water as the level of the water in the cistern altered. This tube was the so-called "composition" tube usually employed by gas-fitters, consisting of lead alloyed with a little antimony. An adjoining cistern of sheet lead with a lead overflow pipe shows nowhere any signs of similar corrosion.

In reference to a remark which the author made as to the protective influence which tin exerted when alloyed with lead, Mr. DAVID HOWARD said that even when the amount of lead in the tin used for tinning vessels employed for culinary purposes did not exceed 5 or 10 per cent it was found to be readily attacked by dilute acids, &c., so as to be likely to produce very injurious effects.

The PRESIDENT said that in the lead tube lined with tin which was made by drawing the two metals at the same time, and when faults occurred in this interior coating the lead was rapidly corroded, although no doubt the faulty parts must be more or less alloyed with tin.

The meeting was then adjourned until Thursday, January 18, when Messrs. C. T. Kingzett and H. W. Hake will give a "Preliminary Account of some New Reactions in Organic Chemistry and their Ultimate Bearing;" there will also be papers "On Kekulé's and Ladenburg's Benzene Symbols," by Dr. H. E. Armstrong, and "On Nitroso-orcin," by Dr. J. Stenhouse and Mr. C. E. Groves. Lectures are announced "On the Theory of the Bunsen Flame," by Prof. Thorpe, and "On the Discrimination of Crystals by their Optical Properties," by Prof. N. Story Maskelyne, both experimentally illustrated; they will probably take place on March 1st and April 5th respectively.

NEWCASTLE-UPON-TYNE CHEMICAL SOCIETY.

General Meeting, October 26th, 1876.

The PRESIDENT in the Chair.

PRESIDENT'S ADDRESS.

(Continued from page 259).

I MUST pass on, as time reminds me, to one or two other subjects, which, although not perhaps so strictly chemical in their nature, are nevertheless not unimportant, whether we regard them as affecting our own science or those of others. And, first, we shall all express unmistakeable satisfaction at the decision come to by our Government last month to take a first step—let us hope not a last—in the direction of the endowment of scientific research. You know that for some years past the sum of £1000 a year has been granted to the Royal Society, chiefly for defraying the expenses of more or less costly apparatus used in carrying out such researches as to the Royal Society should appear worthy of experiment. Within the last twelve months that sum has been supplemented by a further grant of £4000, but on a slightly different footing. Not only may the absolute expenses of research be de-

frayed from that fund, but such allowance may be afforded to experimenters themselves as the Royal Society may consider the researches are worth. I do not say that this is a large step in the endowment of research. I do not say that a nation like ours might not well afford to do more, and might not, perhaps, find that the operation was a far more profitable investment than the purchase of one-hundred-ton guns. But such as this £4000 a year is, we shall judge, I think, that this is a step in the right direction. I cannot, however, help feeling that there are other sources more appropriate perhaps—certainly more adequate to the occasion—to which we might have looked, and to which indeed we have looked, and looked I regret to say to a great extent in vain, for some years. Prominent amongst these, the older universities at once suggest themselves. I have extracted from blue books some figures which, I think, you will agree with me, are not altogether without bearing upon this question. Most people labour under a rather general and rather vague idea, that our older universities—under which term we include Oxford and Cambridge—are enormously wealthy. Wealthy in a sense no doubt they are; but when we come to consider their sources of wealth in detail, we find that really a comparatively small proportion of them is the property of the University. I find that the University of Oxford holds in trust for specific purposes, £15,000; applicable to general purposes, £30,000. Cambridge holds in trust £10,000 for specific purposes; and for general purposes, £23,000. We have, therefore, in round numbers, a sum of about £80,000 a-year, which is the whole income of the Universities proper. Very few people, I fancy, have any distinct idea what a very large share of the management and influence of a University really belongs to the various colleges of which they are constituted. Looking at the sums which are held by the colleges, as contradistinguished from the University, I find that the nineteen colleges of Oxford hold in trust about £35,000, and for general purposes about £330,000 a year from all sources of income. Of Cambridge, the sixteen colleges hold funds amounting to £27,000 in trust, and over £228,000 for general purposes. The grand total, then, at the disposal of the university and colleges is a little over three quarters of a million a year. Now, there is one application of part of that money which I think bears directly (although several of the others bear indirectly) upon the question of what can the universities do for research? And that application is the one known as Fellowships. I find that in all there is something like £101,000 a year expended by the two universities on the payment of Fellows, whose number is nearly the same in the two universities, and amounts in all to rather over 670. Without going into details, I do not think any one will dispute the proposition that, were the older universities really animated with the desire to encourage original scientific research, the colleges would probably apply some fraction of that sum to the endowment of research, instead of the endowment of persons. I cannot, I confess, realise the condition of mind which can conceive it is desirable that a man, simply because at the age of twenty-two or three he has passed a better examination than his fellows; simply because he has happened to show he has some capability of being henceforth useful, should be endowed with a sum of money, coupled in the majority of cases with no conditions as to future work. And I would here refer you to Mr. Vernon Harcourt's address at the Bristol meeting of the British Association for an able statement of the case from the College and University point of view. We are told in this that the universities are exceedingly anxious to endow natural science. We are told, to use Mr. Vernon Harcourt's words—"Nor have the several colleges been backward in allotting scholarships and fellowships whenever they had reason to believe that those elected for proficiency in natural science would be equal in mental calibre to those elected for proficiency in mathematics. But the universities have little power to determine what

number of students shall follow any particular line of study. With certain reserves in favour of classics and mathematics, their system is that of free trade."

But further on in his address Mr. Vernon Harcourt strikes upon a very strong, and, I think, the real, reason why the ablest men do not come up to the universities "in science;" he points out that by the time a man is eighteen or nineteen he has to a certain extent fixed his tastes, and if he has a prejudice in favour of any particular department of study, it will probably be that department to which he has been accustomed from his youth upwards, which he has always been accustomed to hear spoken of as the thing to be kept in view and to be worked at, and to which the *kudos* of his school and the prizes of his university career attach themselves from the very beginning. How is it to be expected that men, however good their brains may be, and however strong their tendency to natural science, should not be deterred from taking up, to any very large extent, or in very considerable numbers, an additional burden? They find they cannot do two things at once; and, therefore, naturally stick to the thing which has been impressed upon them from their youth, and, therefore, sink natural science, and then, I suppose, in time, we shall be told that experience shows the ablest men do not come up in natural science. I have here one or two passages from a leader, interesting, not because the paper in which it appears is one which may be supposed to know much about natural science; but because it is a paper which appeals largely to the class from which university men are drawn. It is not more than six months old, and, as a whole, will repay perusal; but here are one or two bits which especially show what he thinks of the tone of the class he is addressing:—"A first class, rank, or grade, would thus tell its own tale of merit, there would be no spurious new coinage trading upon the repute of attainments in more difficult branches of study. . . . A classical or mathematical first is as much superior to, and as much more arduous than, a first in law, history, or natural science, as in the athletic world a university oar or cricketer puts into the shade one who only plays billiards, rackets, or puts the shot. . . . Not to let a 'first-class man' mean anything from a student in 'stinks and bones' (as the school of natural science is irreverently called at Oxford) to a really talented classic or mathematician, and not to allow silver and alloy to claim equal prestige and value with a pure gold coinage."

I think if this is the atmosphere which pervades our older universities (though I should hope we should hardly find such utter ignorance in anything higher than freshmen) we can hardly wonder that natural science is not much in favour there, and hardly expect that many of the real prizes should be reserved, at any rate for some time to come, for natural science. Looking at the fact that we have had an addition to the national taxation, in order to endow research, you will agree with me that the time is coming when it may be well for the bodies which devote these sums mainly to the encouragement of classics and mathematics to set their houses in order in this respect. There are already some slight signs, we are glad to see, of this setting in order being set about. There is one college at least—I dare say some of you will identify it at once—in Cambridge, where the endowment of research has already become a thing of the present instead of the future—a college where at least one fellowship has been given, not simply on the strength of a man having passed a magnificent examination, which may be worth little or nothing, but on the strength of his having shown promise of original research in a special direction—a promise which one is glad to know has been already fulfilled by his subsequent career.

You are probably aware of the remarkable letter which appeared in the *CHEMICAL NEWS* in January, in which our ex-secretary, Dr. Wright, revived a question which had before agitated the minds of chemists—the question of organisation amongst professional chemists. I should

waste time were I to recapitulate all the discussion which has taken place in the columns of the *CHEMICAL NEWS* and elsewhere—a discussion which unfortunately has served chiefly to mix up two subjects which were not necessarily related to it. That organisation amongst chemists is desirable we shall all, I think, unanimously agree; that something should be done to prevent dabbblers in chemistry, who have picked up a little, and generally a very little, of the practical chemistry connected with what they are pleased to consider their own particular work, styling themselves professional chemists, or applying for official positions of trust—in that we shall all be agreed. But to mix up with this question, the other question, equally important as it is, of the status of the fellowship of the London Chemical Society, is, I think, unnecessary. The case as to this latter question admits of being put exceedingly briefly from two sides of view. One party say the outside world believes that the addition to a man's name of the initials "F.C.S." means something; that that addition really means nothing except that the bearer has been guaranteed by five proposers as likely to pay his subscription with tolerable regularity; and, that these things being so, many people believe that the title will persuade outsiders that they are, what they are not in reality, competent professional chemists. This is one side of the question. On the other side it is contended, and contended with all the weight of official authority, that nobody ever did believe that "F.C.S." meant anything; that at any rate it was never intended to mean anything beyond the fact that its bearer took more or less interest in chemistry; and that if all who claim the title, who have no title to it, were excluded, that would be found to prejudice, financially, the interests of the Society's Journal. That is, I think, a fair statement of the two points of view which have been put forward in the *CHEMICAL NEWS* and elsewhere. Now, with each of these, contradictory as they may seem at first sight, one is very much inclined to agree; and looking to the fact that it would be impossible, at any rate, to make any action which the Chemical Society might take retrospective, one is inclined to think that the abusers of the title might be better dealt with by the powers which the Council at present possess for dealing with such offenders through the bye-laws. I am glad to be able to say that there is every probability that within the next few weeks a scheme will be brought forward, publicly, by the gentlemen who instituted the discussion for forming an organisation which shall, more or less effectually, deal with this question. I believe my own views are somewhat in advance of what the proposers of the organisation endorse. They may possibly be in advance of the views of a good many; but nevertheless they are my views, and I venture to put again before you the suggestions which I advanced two years ago, that this organisation, guild, institution, whatever you please to call it, will be powerless for good, except within very narrow limits, as long as it remains a semi-private body; and that what is really required is legal endorsement and legal power to deal with the questions of professional education and examination. I should spend not one hour but two if I went into the consideration of all the details and all the difficulties of the question; and, therefore, I will not further allude to it.

CORRESPONDENCE.

A NEW PROCESS FOR THE ESTIMATION OF CHICORY IN COFFEE.

To the Editor of the *Chemical News*.

SIR,—I send you the following process for the estimation of chicory in coffee which I have tried with success:—Take 5 grms. of the coffee and pour upon it about 25 c.c. of boiling water and filter; then pour it into a Nessler

tube, and add acetate of lead, which will throw down the colouring matter of the coffee but leave that of the chicory, which can then be estimated by comparing it with a standard of a known quantity of chicory.—I am, &c.,

ALBERT SMITH.

198, Essex Road, Islington.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

Journal of the Russian Chemical Society,
November, 7, 1876.

Ethyl-isopropyl-ketone.—D. Pawloff.—Preparation and properties of this compound, $C_6H_{12}O$.

Trichloral-cyanide.—C. Cech.—A concentrated solution of potassium cyanide added to a saturated aqueous solution of chloral hydrate causes the gradual appearance of a crystalline body, possessing the formula $C_7H_4NCl_3O_3$, and formed by the union of three molecules of chloral with one of hydrocyanic acid. Dry distillation yields chloral and chloralide.

Preparation of Dichloroacetic Acid from Chloral.—C. Cech and P. Schwebel.—The experiments described are entirely of a negative character.

The Mutual Solution of Liquids.—W. Alexeff.—Among various experiments upon solubilities, the author has found that the solubility of water in phenol and of phenol in water increases rapidly at 80° , and that at 84° both liquids can be mingled in all proportions.

Pyro-tartaric Acids, Normal Oxy-pyro-tartaric Acid, and the Isomery of the Pyro-citric Acids.—W. Markownikoff.—The author finds that by the distillation of the four pyro-tartaric acids the normal acid is undecomposed, the methyl-succinic acid changes into the anhydride, while ethyl-malonic acid and dimethyl-malonic acid lose carbonic acid, and are changed into butyric acid and isobutyric acid. A comparison of the melting-point of isomeric compounds shows that it is raised by an increase in the number of side links in the molecule.

Investigation of the "Adonis Vernalis."—T. Lindros.—The author has detected the presence of aconitic acid in the leaves of the *Adonis vernalis*.

Application of the Electric Current to the Study of the Spheroidal State.—M. N. Hesehus.

An Experiment on the Polarisation of Electrodes.—M. R. Colley.

Les Mondes, Revue Hebdomadaire des Sciences,
No. 8, October 26, 1876.

This issue consists of an abstract of the *Comptes Rendus* for October 16, and contains no original chemical or physical matter.

No. 9, November 2, 1876.

A school of anthropology has been opened in connection with the Faculty of Medicine at Paris.

A renal calculus taken from a patient of M. Laborde has been found to contain 75 per cent of ferric oxide.

On the Various Theories to which the Radiometer has given rise.—M. G. Lippmann.

Weight of an Atom of Hydrogen.—M. Annaheim.—The author dissolved 0.0007 grm. of magenta in alcohol and diluted the solution to 1000 c.c. In each c.c. of the liquid there was then 0.0000007 grm. of colouring matter. The liquid thus obtained is poured into a burette of

1 centim. in diameter, and appears decidedly coloured if seen against a white ground. If a drop from the burette, of which 35 go to a c.c., is poured into a small test-tube of 0.8 centim. in diameter the colour is still visible if regarded against a sheet of white paper, along with a drop of pure alcohol in another similar tube. Hence the eye can detect 0.00000002 grm. of magenta. If we suppose that this drop contains only a single molecule of magenta it follows, according to the formula of this colour, that the absolute weight of an atom of hydrogen cannot exceed 0.0000000059 grm., but may fall below this number.

No. 11, November 16, 1876.

Saccharimeter or Polarimeter.—By M. Laurent.—The peculiarities of this instrument cannot be made intelligible without the accompanying diagrams.

Treatment of Sewage.—M. Gerardin.—This paper is devoted to the praises of a secret remedy accidentally discovered by a certain M. Knab. No light is thrown upon its nature and composition, but it is pronounced a better precipitate than sulphate of alumina, with the strikingly contradictory addition that it merely acts upon suspended and not upon dissolved matter.

Reimann's Farber Zeitung.
No. 38, 1876.

Aurantia.—This beautiful orange dye, according to Gnehm, of Zurich, is the ammonia-salt of an acid, which he has described under the name of dipicrylamin. The colour was first manufactured by Bindschedler and Busch, of Bâle, about the end of 1874. This firm, however, has ceased manufacturing the colour, because the salts of the acid in question exert a powerfully irritating action upon the human skin, and occasion eruptions resembling those produced by the application of croton oil. This action, however, depends on idiosyncrasy; i.e., whilst some persons are strongly affected by very dilute solutions, others experience nothing unpleasant from contact with the concentrated liquid.* On the other hand, C. A. Martius remarks that the aurantia prepared by him does not give rise to this phenomenon, and that the experiments undertaken by Salkowsky in the Physiological Institute of the University of Berlin prove the colour to be innocuous. The injurious effects of the Swiss samples must therefore be traced to an impurity. Aurantia, as appears from its composition, is violently explosive, and should be kept slightly moist with glycerin.

* A similar variation is observed in dye works as regards the action of the chromates upon the skin. Certain men are physically unable to dye chrome-blacks on account of the injury to their hands.—Ed. C. N.

MEETINGS FOR THE WEEK.

MONDAY, Jan 1st.—London Institution, 5.

TUESDAY, 2nd.—Zoological, 8.30.

WEDNESDAY, 3rd.—Microscopical, 8.

THURSDAY, 4th.—London Institution, 7.

FRIDAY, 5th.—Geological Association, 8.

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INDEX.

- ACETAMIDE**, action of nitrous acid upon, 163
carbimide, action of *a*-dinitro-chloro-benzol upon, 270
Acetic and alcoholic fermentation of fruits, leaves, and flowers of certain plants, 142
chloride and compound of chloral, 206
Acid, boric, and alkaline borates, action of upon plants, 206
carbonic, contained in waters, 120
chromic, with hydric peroxide, reaction of, 19
formic, volumetric determination of, 32
hydrosulphurous, and persulphide of hydrogen, decolouration of indigo by, 250
thermic researches in, 133
para-xylene, 270
pyro-tartaric, normal oxy-pyrotartaric acid, and the isomery of the pyro-citric acids, 284
selenious, action of hydracids upon, 51
sulphuric, action of upon hydrobenzoin and iso-hydrobenzoin, 270
sulphurous, generating for use as a disinfectant, 245
and soluble sulphates, determination of by means of standard solutions, 9
fuming, 154
representation of the manufacture of, 270
sulphurous, as a disinfectant, 261
tartrate, estimation of potassium as, 231, 242, 249
Acids, citric and acetic, 270
Ackroyd, W., metachromatism, or colour change, 75
Aconites, the alkaloids of, the, 222
Actinometer, differential, 40
Adams, J., "Presence of Arsenic in Vapours of Bone Manure" (review), 68
Affinity, capillary, 205
African International Exhibition, 169
Agriculture, Report of Department of, 174
"Agriculture, Report of for State of Georgia for 1875" (review), 170
Air in mines, measuring, 25, 36
Akerman, R., "Iron Manufacture in Sweden" (review), 259
Albumen, solution of damaged, in pepsin, 184
Alcohol, amyllic, of fermentation, inactive, 144
chemical test for, 137, 191
flame, action of palladium in an, 269
methyl, and dimethyl acetal, 271 on the brain, action of, 158
Alcoholic and acetic fermentation of fruits, flowers, and leaves of certain plants, 142
Alcoholometric method by the distillation of alkalised spirituous liquids, 51
Alcohols, chemical constitution of the, 120, 129
Aldehyds and ketones present in wood spirit, 271
thermic formation of the two isomeric, 123
Aldol, isomeric modification of, 83
Alessandri, L., and C. Conti, detecting adulteration of iodide of lead, 154
Alexejeff, W., mutual solution of liquids, 284
Alizarin, anthraflavon, and an accessory product of the manufacture of artificial, 21
artificial, and extract of madder, distinctive reaction between reds of, 184
dyeing with, 184
nitro, 40
Alkali from seaweed, 201
Alkaline bicarbonates, decomposition of under influence of heat and of a vacuum, 83
borates and boric acid, action of on plants, 205
sulphates, method of titrating, 272
sulphides in dressing hides, 52
sulpho-carbonates, 94
Alkalised spirituous liquids, alcoholometric method by the distillation of, 51
Alkaloid found in damaged Indian corn and mouldy maize bread, 144
Alkaloids of the aconites, 222
Allantoin, synthesis of, 51
Allard, M., dyeing aniline-blacks, 251
report on memoirs by, relating to the transparency of flames and atmospheres, and the visibility of lighthouses with flashing lights, 9
Allen, A. H., analysis of manganese ore, 30, 50
of peroxide of manganese, 8
Alloy, nickel and silver, 150
Almonds, sweet, asparagin in, 238
Alumina, sulphate of, addition of in treatment of sewage, 197
Aluminium, electro-chemical deposits of, 227
Alverginiat (Frères), radiometers composed of laminae of different materials, 83, 92
Amalgamation of iron and other metals, 35
American Chemical Society, 22
Amidous derivatives of hydroxylamin, 153
Ammon aldehyd, compounds derived from, 144
Ammonia contained in waters, disappearance of, 152
upon chlor-acetyl beazol, action of, 270
Amyllic alcohol of fermentation, inactive, 144
Analyses, mineral, 141
of manganese ore, 50
of superphosphates, 221
Analysis and synthesis by the blowpipe, 177
blowpipe, notes on, 27
of butter, 254
of coal and peat, 233
of colours fixed upon tissues, use of hydrosulphite of soda as a reagent in the, 154
of electrolytic aniline-black, 21
of Henwoodite, 156, 172
of iron deposit, 198
of manganese ore, 30
of peroxide of manganese, 8
of raw sugars, commercial, 40
of water of River Houghly, 84
of Weissenburg water, 73
"Analysis, water" (review), 204
Analyst for Cheshire, 174
for Warwick, 184
"Analysts' Annual Note-Book" (review), 38
Analytical query, 164
Andersen, M., barwood, 222
Andrews, T., inaugural address as President of British Association, 97
Aniline-black, 174
dyeing, 251
electrolytic, 21
formation of, 184
in America, use of, 196
vanadium in manufacture of, 92
Aniline introduced into the blood and stomach, researches on the action of, 32
new reaction of, 72
phenol, naphthylamin, and anthraquinon, the electrolysis of the derivatives of, 118
Animal charcoal, 174
organisms, action of turpentine and homologues of phenol, 270
Animals and plants, equivalent substitution of mineral matters in, 134
Annaheim, M., weight of an atom of hydrogen, 284
"Annual Note-Book, Analysts'" (review), 38
Anthracen in coal-tar 94
new derivatives of, 145
new method for ascertaining, 167
new tests for, 279
production, 210, 236, 237
testing, 77, 136, 191, 201, 211, 227, 267
Anthraflavic and iso-anthraflavic acids, 173
Anthraflavon and an accessory product of manufacture of artificial alizarin, 21
Anthrapurpurin and flavo-purpurin, 131
Anthraquinon, aniline phenol, and naphthylamin, the electrolysis of the derivatives of, 118
Antimony, electro-chemical deposits, 227
from stibnite, by nascent hydrogen, evolution of, 147
Apparatus, country laboratory 198
for determination of hydrogen 163
"Appendix Tables to W. Dittmar's Qualitative Chemical Analysis" (review), 68
Aquarium, project of a great, 256
Armstrong, H. E., thymoquinon, 281
Aromatic bases, phthalein of tertiary, 270
carbides, into formenic carbides, transformation of, 184
Aronheim, B., use of molybdenum pentachloride for the production of organic chlorides, 271
synthesis of tolyl-butylene, 271
Araggonite observed on the surface of a meteorite, 32
on the surface of a meteoric iron, 87
Arsenic and copper, separation of, 174
and mercuric cyanide, 167
chromium compound, 220
detection of in wines artificially coloured, 71
"Arsenic in Vapour of Bone Manure" (review), 68, 81, 132, 162
Arseno and phospho-cyanogen, 203
Arsine and mercuric cyanide, 167
Asparagin in sweet almonds, 238
Aspirator, improved form of, 111, 163
Assay of Cinchona bark, Herbellin's method of expeditious, 261
Astringent substances, new process for titrating, 230
Atacamite, note on, 254
Atmosphere, metallic dust in the, 93
Atmospheres and flames, transparency of and visibility of lighthouses with flashing lights, reports on memoirs by Allard relating to, 9
Atmospheric electricity, absorption of free nitrogen by the proximate principles of vegetables under the influence of, 205
Atomic constitution of bodies, 8
theory, note on, 217
Atomically as a principle of classification, 46
reply to certain critical objections by M. J. A. le Bel, 93
Atoms, isolated, real existence of a matter formed of, 98
Atterberg, A., derivatives from *a*-dinitro-naphthalin and *β*-dinitro-naphthalin, 270
constitution of some naphthalin compounds, 270
Aurantia, 284

- Austen, P. T., dinitro-para-dibrom-benzols, 88
- BÄYER, A.**, compounds of phthalic acid with the phenols, 206
- Baird, S. F., "Record of Science and Industry for 1875" (review), 69
- "Balance of Wisdom, Book of the," 59
- Balances, chemical, effect of flexibility on the working of, 14
- Balbani, L., inactive amylic alcohol of fermentation, 144
- Ballmann, H., determination of lithium by means of the spectroscopy, 94
- Banbury, J., tripolite of, 108
- Bard, C.**, and A. Riche, commercial analysis of raw sugars, 40
- Barley in oatmeal, 194
- Barral, J. A., report of on M. Gallard's pneumatic maling-process, 72
- Barbi, A. G., movements produced by light and heat, and on radiometer, 143
- Barth, L., ferrocyanide of tetramethyl ammonium, 217
- Barlett, H. C., and G. O. Drewry, "Food and its Effects" (review), 160
- Barwood, 222
- Bastian, H. C., influence of physico-chemical forces on phenomena of fermentation, 71
- Baumann, E., synthesis of hydrogen-phenyl-sulphate and its homologues, 200
- and K. V. D. Velden, action of the turpentine upon animal organisms, 270
- and E. Hertel, action of homologues of phenol upon animal organisms, 270
- Baxendale, M., protection of buildings from lightning, 246
- Beccquerel, E., observations of spectrum below red ray by means of the effects of phosphorescence, 82
- and M. M. Jamin and Puisseux, report on memoirs by Allard, relating to the transparency of flames and atmospheres and the visibility of light-houses with flashing lights, 9
- Bellamy, F., syphonment and migration of gases, 184
- Bennett Bros., new tests for anthracene, 279
- J., anthracene production, 237
- Benzhydropyric ethylester, 41
- Benzin, constitutions of the derivatives of, 142
- Benzol, action of sodium on, 24
- Benzyl-iso-phthalic acid, 270
- Bernard, E., critique on glycemia, 109
- Berthelot, M., absorption of free hydrogen under the influence of the electric effluve, 93
- of free nitrogen by organic matters at ordinary temperatures, 9
- of free nitrogen by the proximate principles of vegetables under the influence of atmospheric electricity, 205
- chemical phenomena produced by electricity of tension, 272
- formation and decomposition of binary compounds by the electric effluve, 21, 93
- real existence of a matter formed of isolated atoms, 93
- thermic formation of ozone, 93
- formation of the two isomeric propylic aldehyds, 133
- researches on hydro-sulphurous acid, 133
- transformation of aromatic carbides into formic carbides, 184
- Bertrand, A., production of electro-chemical deposits of aluminium, 227
- Betulin, contributions to the history of, 164
- Beutell and Claus, M.M., action of cyanide of potassium upon halogenated compounds, 218
- Bicarbonate of soda at 100°; dissociation of, 152
- Biedermann, R., gaulterylene, 215
- oxymercaptans, 218
- Binary compounds by the electric effluve, formation and decomposition of, 21, 93
- Binney, E. W., remarkable meteor, 247
- Bischof, G., corrosion of lead by New River Company's water, 282
- Inns of Court pumps, 19
- Bismuth, certain new salts of, 119
- compounds, 203
- copper and calcium, detection of, 16
- electro-chemical deposits of, 227
- Bizao, G., galatin, 144
- Black, aniline, 174
- dyeing, 251
- formation of, 184
- use of in America, 196
- Blake, J., Koscovite: a vanadium mica, 46
- Blatzbecker, A., and T. Zincke, benzyl-iso-phthalic acid, 270
- Blowpipe, analysis and synthesis by the, 177
- notes on, 27
- D lines spectra, flame examined by, 214, 226, 237
- with spectroscope for mineralogists, 191
- Blood, action of aniline introduced into the, 32
- Blunt, T. P., rose-colour observed in manufacture of chlorate of potash, 171
- Böetlinger, C., ultramarine, 163
- Boillot, A., production of electric effluve, 13, 216
- Bolley, P. A., and E. Kopp, "Manual of Chemical Analysis" (review), 171
- Bolton, H. C., "Book of the Balance of Wisdom," 59
- "Bone-Manure, Presence of Arsenic in Vapours of" (review), 68, 81, 132, 162
- Borates, alkaline, and boric acid, action of on plants, 205
- Doron, 206
- Böttger, C., action of zinc dust on the chlorides of subphosphato-bromo-benzoic acid, 271
- Bouillet, H., and P. Christoffe, metallic nickel extracted from the ores of New Caledonia, 50
- Bouillon, E., magenta in wine, 227
- Bouquet de la Grye, extraction of vanillin from the sap of the pine, 144
- Bourgoing, E., atomicity as a principle of classification, 46
- note on atomic theory, 217
- reply to critical objections on atomicity by J. A. Le Bell, 93
- Boussingault, J., saccharine matter contained in the petals of flowers, 273
- Brain, action of alcohol on the, 158
- Brautwaite, W. and J., "Retrospect of Medicine" (review), 19
- Brazilin, formula of, 271
- Briggs, R., "Ventilation of Hall of Representatives and Senate Wing of Capitol of United States" (review), 235
- Briosi, G., hesperidin, 72
- British Association for the Advancement of Science, 22, 97, 122
- Sewage Committee of, 136
- Pharmaceutical conference, 84
- Bromine, silver oxide, and water, oxidation-product of glycogen with, 153
- Bronze, phosphor, and phosphide of copper, applications of, 217
- Bronzes, ancient, arsenic in, 41
- Brown, J. T., anthracene testing, 136
- Brugnatelli, T., and E. Zenoni, alkaloid found in damaged Indian corn and mouldy maize bread, 144
- Bühning, Meister, and Lucius, M.M., method for ascertaining anthracene, 167
- Brussels, Hygienic Congress at, 170
- Buhrig, H., preparation, atomic weight, and determination of cerium free from didymium, 94
- Buildings, protection of from lightning, 246
- "Bulletin of the Bussey Institution" (review), 90
- Butter, analysis of, 254
- Butylen-tolyl, synthesis of, 271
- Butylic glycol, new, 63
- CADMIUM**, electro-chemical deposits of, 227
- Calcium, copper, and bismuth, detection of, 16
- quino-acetate of, 8
- sulphate of, 256
- Calcite and quartz, oxide of iron enclosed in, at Mwyndy Mines, 10
- Calculus in horses, 151
- Calderon, L., rotatory powers of cane-sugar, 110
- Cameron, C. A., estimation of colour in water, 77
- Camphols, isomerism of the rotatory power in the, 92
- Cane-sugar, cellulosic fermentation of, 63
- rotatory power of, 160
- "Cane-Sugar, Disease of" (review), 272
- Carbimide and acetamide, action of a dinitro-chlorobenzol upon, 270
- Carbon, bisulphide of, purification of, 184
- compounds of found in meteorites, 32, 153
- Carbonates, insoluble decomposition of by sulphuretted hydrogen, 51
- Carbides, aromatic, transformation of into formic carbides, 184
- Carnelly, T., high-melting-points, with special reference to those of metallic salts, 281
- Carnot, A., certain new salts of bismuth, 119
- process for the qualitative detection and determination of potassa, 85, 216
- Capellini, G., and M. Sansoni, magistrity of sulphur, 154
- Casamajor, P., amalgamation of iron and other metals, 35
- estimation of potassium as acid tartrate, 231, 242
- Caspers, C., anthracene testing, 211
- Cast-iron, copper in, 78
- Capillary action and cohesion of films of water, 223
- affinity, 205
- Cazenave, P., metallisation of organic bodies to render them fit to receive galvanic deposits, 9
- Cec, C., trichloral cyanide, 284
- and P. Schwabel, preparation of chloroacetic acid from chloral, 284
- Cerium free from didymium, preparation, atomic weight, and determination of, 94
- Cevvenne, mercury in, 40
- Chateau, T., historical and chemical survey of the manufacture of Turkey red, 196
- Champion, P., and H. Pellet, determination of free nitrogen in organic substances, 205
- equivalent substitution of mineral matters in animals and plants, 134
- Charcoal, animal, 174
- Chemical arts, development of during the last ten years, 5, 13, 25, 33, 45, 55, 66, 78, 86, 118, 139, 149, 166, 180, 183, 197, 215, 220, 233, 245
- balances, effect of flexibility on the working of, 14
- decomposition as illustrated by water, 43
- lecture classes and laboratory instruction, 117
- phenomena produced by electricity of tension, 272
- questions, 91
- Society, 1, 6, 7
- American, 22
- German, 280
- Newcastle, 256, 282
- research fund, 196
- "Chemical Notes in Rhyme" (review), 5
- "Chemical Students, Note-Book and Lecture Notes for" (review), 259
- Chemistry, new scholarship in at Owens College, 196
- practical, in University of Virginia, 147, 168, 179, 190
- schools of, 111
- "Chemistry, Legal, Detection and Examination of Poisons and Stains" (review), 18
- "Chemistry, Practical for the Use of Medical Students" (review), 89
- Chemists, organisation among, 39, 227, 238
- Chevrel, E., capillary affinity, 205
- Chiappe, P., and O. Malesci, preparing the iodides of potassium and sodium, and the bromide of potassium, 154
- Chicory in coffee, new process for estimation of, 283
- Chilian minerals, examination of, 134
- Chittenden, R. H., oxidation product of glycogen with bromine, silver oxide, and water, 153
- Chlor-acetyl-benzol, action of ammonia on, 270
- Chloral, compound of, and acetic chloride, 206
- Chlorides, organic, use of molybdenum pentachloride for the production of, 271
- Chlorine, manufacture of, 70
- reaction of under influence of porous carbon, 63
- substitution, study of, 11
- Chloro-benzol, a-dinitro, action of upon acetamide and carbamide, 270
- Chloroform, test for purity of, 191
- Christoffe, P., and H. Bouillet, metallic nickel extracted from the ores of New Caledonia, 50
- Chromic acid with hydric peroxide, reaction of, 19
- Chromium arsenic compound, 220
- Church, A. H., colein, 256
- dyosidite, 155
- "Chymistry" and force, 123
- Cinchona barks, Herbelin's method for expeditious assay of, 261
- Cinchonic alkaloids, behaviour of phenol with the, 153
- Clarke, F. W., "Constants of Nature" (review), 142
- T., "Treatment of Ores" (review), 50
- Claus and Beutell, M.M., action of cyanide of potassium upon halogenated compounds, 218
- Clay in water, suspension of, 142
- Cloëz, S., modifications of elcomargic acid produced by light and heat, 272

- Cloud, T. C., note on atacamite, 254
Coal and peat, quantitative analysis of, 233
Gas of the Metropolis, 223
Proximate composition of, 145
mines, fire-damp in, 110
tar, anthracen in, 94
Cobalt and nickel, new method of separating, 255
Cockroach, phenomena of digestion in, 261
Coffee, study on, 142
Cohesion and capillary action of film of water, 223
Cohne, S., formation of ozone by the contact of plants with peroxide of hydrogen, 4
Colein, 256
Coleman, J. J., chemical treatment of town excreta, 125
Collev, M. R., polarisation of electrodes, 284
Collins, J. H., new mineral from Phoenix Mine, 10
occurrence of pharmacosiderite, scorodite, and olivenite in greenstone at Terras Mine, 10
Colour change, 75
estimation of in water, 77
Colouration, heat, 108, 132
Colouring matters in wines, determination of the nature of, 238
new class of, 143
"Colourist, Textile" (review), 89
Combustion tubes, platinum, 67, 81
Commaile, A., study on coffee, 142
Commercial oils, assay of, 154
Compass with circular magnets, 250
"Constants of Nature" (review), 142
Cooking vessels, enamelled, 130
Copper and arsenic, separation of, 174
calcium, and bismuth, detection of, 16
in cast-iron, 78
metallic, action of fatty oils on, 176, 200, 213
phosphide of and phosphor-bronze, applications of, 217
sulphate, hydrates of, 238
wire ropes, inconvenience of for lightning conductors, 9
Coquillion, J., determination of hydrocarbons, 110
limits within which the explosion of fire damp is possible, 205
Cornish mineral, 147
Cornwall, H. B., notes on blow-pipe analysis, 27
Cousre, C., chloride of calcium for watering roads, &c., 110
and Alessandri, L., detecting adulteration of iodide of lead, 154
Cremation, report on, 261
Crookes, W., experimental contributions to the theory of the radiometer, 269, 275
repulsion resulting from radiation, 23, 165, 175, 187, 209, 219, 229, 241, 253, 261
"Cup and Plate" (review), 160
Curie, J., and Millet, A., compound of chloral and of acetic chloride, 206
Cyanide, mercuric, action of on phosphine, 167
and arsine, 167
Cyanogen, 67
DAVIES, R. P., dysodile, 195
Davis, G. E., organisation among chemists, 39
pink liquors of chlorate of potash manufacture, 183
Davy, E. W., chemical test for alcohol, 137
Day, R. E., "Electrical Magnetic Measurements, Exercises in, with Answers" (review), 161
De Almeida, G. O., and Guignet, E. A., meteoric iron rich in nickel, 238
De Boisboudran, L., chemical reaction of gallium, 183, 217
new process for extraction of gallium, 173
physical properties of gallium, 150
Debray, H., and Deville, H. Ste. C., physical and chemical properties of ruthenium, 265
De Clermont, P., and Wehrin, E., two new sulphuretted ureas, 92
De Fontenay, Moutchal, and De Ruolz, H., applications of phosphide of copper and phosphor-bronze, 217
De Fonvielle, W., differential radiometer, 32, 51, 63
intensity radiometers, 110
De Girard, J., cause of the spontaneous alteration of anhydrous hydro-cyanic acid, 92
De Lalande, F., purpurin, 10
De la Source, L. M., hydrates of copper sulphate, 238
De Luca, S., alcoholic and acetic fermentation of fruits, flowers, and leaves of certain plants, 142
De Montgolfier, J., isomerism of the rotatory power of the camphors, 92
De Montholon, F., and Naudin, L., decomposition of cyanide of potassium, cyanide of zinc, and formate of potassa in carbonic acid, air, and pure hydrogen, 92
insoluble carbonates by sulphuretted hydrogen, 51
Denman, J. L., "Wine and its Counterfeits" (review), 90
Denayrouze, L., electric lamp designed by P. Jabloschkoff, 217
De Farville, H., "Causeries Scientifiques" (review), 69
De Koolz, H., Moutchal, and De Fontenay, applications of phosphide of copper and phosphor-bronze, 217
De St. Venant, J., atomic constitution of bodies, 8
Deuchemin's compass with circular magnets, 250
Deville, H. Ste. C., and Debray, H., physical and chemical properties of ruthenium, 265
Diamin phenylen, 256
Dichloroacetic acid, preparation of, from chloral, 244
Dickinson, J., measuring air in mines, 25, 36
Didelot, J., detection of magenta in sophistication of wines, 152
Didymium, preparation, atomic weight, and determination of cerium, free from, 94
Dimethyl-acetal and methyl-alcohol, 271
Dinitro-chloro-benzol upon acetamide and carbamide, action of, 270
Dinitro-naphthalin (a and β), 270
Dinitro-para-dibrombenzols and their derivatives, 88
Diplate-nitrates and platonitrates, 270
"Discursive Chemical Notes in Rhyme" (review), 5
"Diseases, Typhoid Fever and Allied, How to Avoid" (review), 181
Disinfectant, sulphurous acid as a, 261
Ditte, A., action of hydric acids upon selenious acid, 51, 72
tellurous acid, 92, 133
Dittmar, Prof., and the "Analyst," 130, 151, 162, 172, 183
proximate composition of coal-gas, 145
D-lines spectra flame examined by the blowpipe, 212, 226, 237
Domejko, M., examination of Chilean minerals, 134
Dott, D. B., note on Dr. Davy's test for purity of chloroform, 189
Doulriot, E., charge assumed by the disc of the electrophorus, 8
Downes, A. H., "How to Avoid Typhoid Fever and Allied Diseases" (review), 181
Drewry, G. O., and Bartlett, H. C., "Food and its Effects" (review), 160
Dubois, M., Herbelin's method for expeditious assay of cinchona barks, 261
Ducretet, E., radiometer of Mr. Crookes, 51
Dulong and Petit, law of, 9, 21
Du Moncel, Th., electric transmissions through the soil, 142
Dupré, A., Heisch, C., Prof. Dittmar and the "Analyst," 172
the Chemical Society, 6
Durassier and Tréve, MM., distribution of magnetism on the surface of magnets, 217
dynamo-magnetic phenomenon, 227
etching action produced upon different metals by the acids, 206
Durin, E., cellulosic fermentation of cane sugar, 63
Dyeing aniline-blacks, 251
Dynamite, experiments with frozen, 22
manufacture of, 93
Dysodile, 155, 195
EGOROFF, N., differential actinometer, 40
Elzomargic acid, modifications of produced by light and heat, 272
Electric effluve, formation and decomposition of binary compounds by, 47, 63
formation of, 183, 210
lamp, 217
transmissions through the soil, 142
"Electrical and Magnetic Measurements, Exercises in, with Answers" (review), 161
Electricity of tension, chemical phenomena produced by, 272
Electro-chemical deposits of aluminium, magnesium, cadmium, bismuth, antimony, and palladium, 227
Electrolysis of the derivatives of aniline, phenol, naphthylamin, and anthraquinon, 113
Electrolytic aniline-black, 21
Electrophorus, charge assumed by the disc of, 8
Ellstone, W., separation of arsenic and copper, 174
Eltoft, T., "Note Book and Lecture Notes for Chemical Students" (review), 259
Emodin from the bark of the Rhamnus frangula, 271
Enamelled cooking vessels, 130
Endosmotic lixiviation, manufacture of soda from seaweed by, 31
Eruptive rocks, origin of, vitreous and crystalline, 206
Erythrogen and some of its compounds, 31
Estcourt, C., butter analysis, 254
Etching action produced upon different metals by the acids, 206
Ethide, stannous, oxidised product formed during reduction of stannic ethide to, 203
Ethyl-iso-propyl-ketone, 284
Eucalyptus globulus, sanitary effects of, 272
Excreta, town, chemical treatment of, 125
Exhibition, South African, 169
"Explosive Agents, Certain" (review), 272
Explosives, carriage of, 144
FAVE, M., probable consequences of the mechanical theory of heat, 172
Feltz, J., and Ritter, E., researches on the action of aniline introduced into the blood and the stomach, 32
Fermentation, influence of physico-chemical forces on phenomena of, 71
Ferments, origin of organic, 9
Ferricyanide of potassium, action of halogens on, 217
Ferrocyanide of tetramethyl ammonium, 217
Field, F., new Cornish mineral 147
the late David Forbes, 260
Filters, action of on organic substances, 4, 11, 24
Filtration, rapid, 57
Filsinger, F., borates of lithium, 184
Fire damp in coal mines, 110
limits within which it is possible, 205
Fires, coloured, used in pyrotechny, 139
Fischer, E., hydrazinic compounds of the fatty series, 218
O., action of nitrous acid on acetanilide, 163
phthaleins of tertiary aromatic bases, 270
Flame, luminous theory of, 152, 206
and atmospheres, transparency of, and the visibility of light-houses with flashing lights, 9
Flavo-purpurin and anthro-purpurin, 131
Fletcher, T., Dr. J. W. Hearder, F.C.S., 30
Fleurens, G., crystallisation of sugar, 65
Flight, W., Prof. Wöhler, 249
Flowers, fruits, and leaves of certain plants, alcoholic and acetic fermentation of, 142
Fluid cavities, a further study of, 251
The silicates, crystalline, of iron and cobalt, 184
Folsom, C. F., "Report of State Board of Health of Massachusetts" (review), 182
"Food and its Effects" (review), 160
Foqué, M., mineralogical and geological researches on the lavas of dykes of Théra, 238
Forbes, D., the late, 260
Force and "Chymistry," 123
Forsdos, M., detection of magenta in wines, 273
Formenic carbides, transformation of aromatic carbides into, 184
Formiate of potassa, decomposition of in carbonic acid, air, and pure hydrogen, 92
Formic acid, volumetric determination of, 32
Forster, R., dyeing with artificial alizarin, 184
Fonvielle, M. de, the radiometer, 8
Franck, A., action of water on glass, 271
Free nitrogen, absorption of by organic matters at ordinary temperatures, 9
Freezing machines with sulphurous acid, 52
Fremy, E., salts formed by the peroxide of manganese, 8
Friction, simple, of soft iron against cold steel to melt it, 46
Friedour, L. H., purification of bisulphide of carbon, 184
Fruits, leaves, and flowers of certain plants, a colonic and acetic fermentation of, 142
Furnace, decomposing, 42
discussion on Jones and and Walsh's, 27
Furstenau, E., ultramarine, 196
GAIFFE, A., note on the radiometer, 83

- Galatun, 144
Gallium, chemical reaction of, 193, 217
new process for extraction of, 173
physical properties of, 150
Galvanic deposits, metallisation of organic bodies to render them fit for, 9
Garnier, J., nickel ore of New Caledonia, or Garnierite, 40
Gauguin, J. M., influence of temperature upon magnetisation, 238
Gaulterien, 218
Gautier, A., decomposition of alkaline bicarbonates under the influence of heat and a vacuum, 83
Gehe and Co., of Dresden, trade report, 144
Gelis, A., use of alkaline sulphides in dressing hides, 52
Genth, F. A., American vanadium minerals, 78
Geological and mineralogical researches on lavas of dykes of Thera, 238
"Geology and Physics, Elementary" (review), 154
"Georgia, Report of Agriculture for State of" (review), 170
Georgia, sheep husbandry in, 195
Gerardin, M., treatment of sewage, 284
Gerland, B. W., notes on vanadium compounds, 2
Girard, A., transformation of saccharose into reductive sugar during reining, 71
Gladstone, J. H., chemical decomposition as illustrated by water, 43
Glass, action of water on, 271
Globular thunderbolts, 92
Glucose, detection of, 154
Glycemia, critique on, 109
observations on, 109
Glycerin, derivatives of, 153
Glycerol, oxidation-product of with bromide, silver oxide, and water, 153
Glycol, butylic, 63
Gold in pyrites, 94, 132, 152, 172
Goppelsröder, F., electrolysis of the derivatives of aniline, phenol, naphthylamin, and anthraquinon, 118
elementary analysis of electrolytic aziline-black, 21
Govi, M., cause of movements in the radiometer, 40, 51
Graham, A., effects by addition of sulphate of alumina in the treatment of sewage, 197
Graz, communications from the University Laboratory of, 153
Griffin, W., new gas-bottle, and arrangements of apparatus for applying sulphuretted hydrogen without smell and avoiding its escape, 230
Greenstone at Terras Mine, occurrence of pharmacosiderite, scrodite, and olivine in, 10
Grimoux, L., synthesis of allantoin, 51
Guainin in the urine of swine, 206
Guibourt, M., oil of wood, 85
Guignet, L., and G. O. de Almeida, a meteoric iron rich in nickel, 238
and A. Telier, chemical composition of the water of Bay of Rio de Janeiro, 238
Guillemaire, A., lighting by means of products from resinous trees, 163
Gundelach, C., derivatives of isoxylene, 40
quino-acetate of calcium, 8
Guthrie, F., solid water, 161
Guyard, A., metallurgy of silver in the moist way, 41
method of separating nickel and cobalt, 255
Halogens, action of upon ferricyanide of potassium, 217
Hampe, W., boron, 206
Hannay, J. B., calcium sulphate, 256
effect of temperature upon the growth of potatoes, 155
Hardman, E. T., country laboratory apparatus, 198
flame of chloride of sodium in a common fire, 90
Hart, E., volumetric estimation of iron, 65
Hartley, W. N., a further study of fluid cavities, 281
Hausmann, U., contributions to history of betulin, 164
Hayden, F. V., new work by, 228
Hearder, Dr. J. W., F.C.S., 20, 30, 32
Heat and light, modifications of elasmogargic acid produced by, 272
oxygen, combustion of organic matters under the double influence of, 9
colouration, 108, 132
probable consequences of the theory of, 172
Heats of a gas, relation of the two specific, 206
Hedrick, B. S., requisite amount of simple friction of soft iron against cold steel to melt it, 46
Heighman, W., "Practical Portrait Photography" (review), 225
Hill, W. N., "Certain Explosive Agents" (review), 272
Hleisch, C., and A. Dupré, "Prof. Dittmar and the 'Analyst,'" 172
Hemwoodite, 156, 172
Herbelin's method for expeditious assay of cinchona barks, 261
Herland, L., process for the manufacture of soda from seaweed by endosmotic lixiviation, 31
Herman, W. D., platinum combustion tubes, 81
Herter, E., and E. Baumann, action of homologues of phenol on animal organisms, 270
Hescheus, M. N., application of the electric current to the study of the spheroidal state, 284
Hesperidin, 72
Hesse, O., behaviour of phenol with the cinchonic alkaloids, 153
Heumann, K., representation of the manufacture of sulphuric acid, 270
theory of luminous flames, 152, 206
Hides, use of alkaline sulphides in dressing, 52
Hildebrand, E. C. H., rapid filtration, 57
Hirn, G. A., maximum of the possible repulsive power of the solar rays, 31
reply to by A. Ledieu, 83, 110
Hodgkinson, W. R., and G. C. Matthews, oxidised product formed during the reduction of stannic ethide to stannous ethide, 293
and H. C. Sorby, pigmentum nigrum, 203
phosphor- and arseno-cyanogen, 203
Hofmann, A. W., development of the chemical arts during the last ten years, 5, 13, 25, 33, 45, 55, 66, 78, 86, 118, 139, 149, 166, 180, 188, 197, 215, 220, 233, 245
P. W., extraction of sulphur from pyrites, 218
"Homoeopathy, Errors of" (review), 70
Houzeau, A., determination of the carbonic acid contained in waters, 110
disappearance of the ammonia contained in waters, 152
Hooghly river, analysis of, 84
Horses, calculus in, 151
Human corpse, natural poisonous nature of the, 144
Humpidge, T. S. D., coal-gas of the Metropolis, 223
Hunau, P., citric acid and aconitic acid, 270
Hunyadi, Janos, "Natural Mineral Water" (review), 90
Hurter, F., arsenic in vapours of bone-manure, 81
Husson, C., detection and determination of arsenic in wines artificially coloured, 71
Hutchings, W. M., notes on mineral analyses, 141
Hydrazinic compounds of the fatty series, 218
Hydracids, action of upon selenic acid, 52, 72
tellurous acid, 92, 133
Hydric peroxide, reaction of with chromic acid, 19
Hydrobenzoin and iso-hydrobenzoin, action of dilute sulphuric acid upon, 270
Hydrocarbides, preparing condensed, 174
Hydrocarbons, determination of, 110
Hydrogen, apparatus for the determination of, 163
evolution of antimony from stibnite by nascent, 147
free, absorption of under the influence of the electric effluve, 93
peroxide of, formation of ozone by the contact of plants with, 420
Hydrogen, sulphuretted, precipitation of zinc by in presence of bisulphate of potassium, 94
weight of an atom of, 284
Hydrogen-phenyl-sulphate and its homologues, synthesis of, 269
Hydroxylamin, amidous derivatives of, 153
Hygienic congress at Brussels, 170
Hygiene, industrial, prize in, 167
ILES, M. W., detection of copper, calcium, and bismuth, 16
Indian corn and mouldy maize bread, alkaloid found in, 144
Indigo, decolouration of by hydro-sulphurous acid and persulphide of hydrogen, 250
"Industry and Science, Record of" (review), 60
Infusoria and nitrate, 33
Inns of Court pumps, 19
Insoluble carbonates, decomposition of by sulphuretted hydrogen, 51
Iodine as a reagent for starch, 72
Iron and cobalt, crystalline fluosilicates of, 184
other metals, amalgamation of, 35
Steel Institute, 123
deposit, analysis of, 198
preservation of from action of salt, 174
"Iron Manufacture in Sweden" (review), 259
Iron, meteoric, rich in nickel, 238
oxide of, enclosed in calcite and quartz at the Mwyndy Mines, 10
volumetric estimation of, 65
Iso-anthraflavic and anthraflavic acids, 173
Iso-hydrobenzoin and hydrobenzoin, action of dilute sulphuric acid upon, 270
Isomeric aldehyds, thermic formation of the two, 133
Isomerism of the rotatory power of the camphols, 92
Isoxylene, derivatives of 40
Jacquemin, E., detection of manganate in wines, 51
rhodine from an analytical point of view, 133
new reaction of aniline, 72
Jamin, Puisseux, and E. Becquerel, reports on memoirs by Aillard relating to the transparency of flames and atmospheres, and the visibility of light-houses with flashing lights, 9
Jean, F., determination of nitrates, 41
method of titrating alkaline sulphates, 272
new process for titrating as-tringent substances, 230
Jeannel, J., influence of sonorous vibrations on the radiometer, 133
Johnson, G. S., potassium tri-iodide, 222
Jones and Walsh's decomposing furnace, discussion on, 27
H. C., determination of lithium by means of the spectroscope, 122
Joubert, J., and M. Pasteur, fermentation of urine, 150
"Journal of Iron and Steel Institute" (review), 22
KAINITE of Kalusz in Galicia, 184
Keates, T. W., generating sulphurous acid for use as a disinfectant, 245
Kern, S., coloured fires used in pyrotechny, 139
presence of copper in cast-iron, 78
quantitative analysis of coal and peat, 233
Ketone, para-tolyl-phenyl-, derivatives of, 270
Ketones and aldehyds present in wood-spirit, 271
Kimball, A. S., changes in the physical properties of steel by tempering, 81
Kingzett, C. T., action of alcohol on the brain, 153
formation of oxone by the contact of plants with peroxide of hydrogen, 20
limited oxidation of essential oils, 127, 137
Klippert, L., and T. Zincke, para-xylene, acid, 270
Kollmeyer, A. H., "Key to Modern Science" (review), 271
Kopp, E., and P. A. Bolley, "Manual of Chemical Analysis" (review), 171
Krafft, L., fermentation of urine, 250
Kraemer, G., and H. Troschke, methyl-alcohol and dimethyl-acetal; aldehyds and ketones present in wood-spirit, 271
Kraut, R., derivatives of glycerin, 153
LABORATORY apparatus, country, 198
instruction, lectures and classes, 117
of Graz University, communications from, 153
Lamaltina, L., detection of wines artificially coloured, 152
Laudrin, E., pepper and its adulterations, 154
Laurent, M., saccharimeter or polarimeter, 284
Lauth, C., new class of colouring matters, 143
Lavas of Dykes of Thera, researches on, 238
Lead, corrosion of by New River Company's water, 282
iodide of, detecting adulteration of, 154
sulpho-antimonuret found at Arnberg, 206
poisoning, 196
HALL, M., blowpipe with spectroscope for mineralogists, 91

- Le Bel, J. A., reply to certain objections on atomicity, 93
 Le Neve Foster, C., Henwoodite, 172
 pyrophyllite at Brookwood, and new mineral localities in Devon and Cornwall, 10
 Leaves, fruits, and flowers of certain plants, and alcohol and acetic fermentation of, 142
 "Lecture Notes and Note-Book for Chemical Students" (review), 259
 Leduc, A., study of the radiometer, 8, 9, 21, 31, 63, 110
 "Legal Chemistry" (review), 18
 Levy, A. M., origin of eruptive rocks, vitreous and crystalline, 206
 Leymerie, M., existence of mercury in the Cevennes, 40
 Liebermann, C., and M. Waldstein, emodin from the bark of the *Rhamnus frangula*, 271
 constitution of oxythymoquinone, 271
 formula of brazilin, 271
 Light and heat, modifications of elcomargic acid produced by, 272
 chemical force of, 195
 Lighthouses, visibility of with flashing lights, 9
 Lighting by products from resinous trees, 163
 Lightning, bead, 134
 effect of during the storm of August 18, 134
 Lime, fossil deposits of phosphate of in the departments of Ardennes and La Meuse, 21
 influence of salts of on saccharimetry, 9
 Lindros, T., investigation of the *Adonis vernalis*, 284
 Lippmann, G., various theories to which the radiometer has given rise, 284
 Liquids, mutual solution of, 284
 Lithium, borates of, 184
 determination of by means of the spectroscopic, 94, 122
 Litmus, note on, 140, 184
 Liversidge, A., "Disease of Sugar-Cane" (review), 272
 Lixivation, manufacture of soda from seaweed by endosmotic, 31
 Löwe, J., quercitrin and quercetin, 184
 Loiseau, D., combustion of organic matters under the double influence of heat and oxygen, 9
 London University, 206, 251, 268
 Louguine, W., correspondence from St. Petersburg, 250
 Lucas, R., anthracen testing, 267
 Lucius, Meister, and Brüning's method for ascertaining exact quantity of pure anthracen contained in crude anthracen, 167
 Luminous flames, theory of, 152, 206
 Lunge, G., apparatus for making chlorate of potash, 151, 139
 Lupton, S., oxides of potassium, 203

MACHATTIE, A. T., presence of arsenic in the vapours of bone manure, 162
 Madder, extract of, and artificial alizarin, distinct reaction between reds of, 184
 "Madras Government, Public Works Department" (review), 272
 Magneta in wines, detection of, 51, 152, 227, 272
 Magnesium, electro-chemical deposits of, 227
 "Magnetic and Electrical Measurements, Exercises, in with Answers" (review), 161
 Magnetic dynamo-phenomenon, 227
 Magnetisation, influence of temperature upon, 238
 Magnetism on surface of magnets, distribution of, 217
 Magnets, circular, Duchemin's compass with, 250
 distribution of magnetism on surface of, 217
 Maize, mouldy bread, and damaged Indian corn, alkaloid found in, 144
 Malesci, M., and P. Chiappe, preparing the iodides of potassium and sodium, and the bromide of potassium, 156
 Maley, R., compounds of sulphurea with metallic salts, 227
 Maltng process, pneumatic, of M. Gallard, 72
 Mallet, J. W., notes of practical chemistry in University of Virginia, 147, 168, 179, 190
 Manetti, L., and G. Muso, salicylic acid in the milk trade, 142
 Manganese ore, analyses of oxides of, 39
 analysis of, 30, 50
 analysis of peroxide of, 8
 salts formed by the peroxide of, 8
 Manganic oxide, determination of, 19
 "Manure, Bone, Presence of Arsenic in Vapours of" (review), 68, 81, 132, 162
 Manzoni, G. S., reagents on the principal organic colouring matters, 144
 use of hydrosulphite of soda as a reagent in the analysis of colours fixed upon tissues, 154
 Margarine chlorides and its derivatives, 238
 Markownikoff, W., pyro-tartaric acid, normal oxy-pyro-tartaric acid, and the isomery of the pyro-citric acids, 284
 Martin, A., "Hunyadi János, Natural Mineral Water" (review), 90
 "Massachusetts Institute of Technology" (review), 141
 "Massachusetts, Report of State Board of Health" (review), 38, 182
 Matthews, G. C., and W. R. Hodgkinson, oxidised product formed during reduction of stannic ethide to stannous ethide, 203
 Mauméné, E., alcoholometric method: by the distillation of alkalised spirituous liquids, 51
 Meadows, B., "Errors of Homoeopathy" (review), 70
 Meat, occurrence of germs of the tape-worm in, 83
 "Medicine, Retrospect of" (review), 19
 Meissonier, M., bed of nickel ores in Spain, 72
 Meister, Lucius, and Brüning's method for ascertaining anthracen, 167
 Meldola, R., the Chemical Society, 7
 Melsens, M., reactions of chlorine under influence of porous carbon, 63
 Mercuric cyanide, action of phosphine on, 167
 and arsenic, 167
 Mercury in the Cevennes, 40
 Mermet, M. A., alkaline sulphocarbonates, 94
 Metachromatism, or colour-change, 75
 Metallic copper, action of fatty oils on, 176, 200, 213
 dust in the atmosphere, 93
 nickel extracted from ores of New Caledonia, 50
 salts, sulpho-area with, 217
 Metallisation of organic bodies to render them fit to receive galvanic deposits, 9
 Metals, amalgamation of iron and other, 35
 Metals, etching action produced upon different, by the acids, 206
 Meteoric iron, arragonite on the surface of, 87
 rich in nickel, 238
 Meteorite, arragonite observed on the surface of, 132
 Meteorites, compounds of carbon found in, 32
 solid compounds of carbon in, 153
 Meteor, remarkable, 247
 Methyl-alcohol and dimethyl-acetal, 271
 "Metre-diagram" (review), 151
 Metropolis, composition and quality of the water of the, 216
 coal-gas of the, 223
 Meyer, R., formation of aniline-black, 184
 Mica vanadium, 46
 Michael, A., and Norton, T. H., preparation and properties of tri-iodo-resorcin, 270
 Michel, R. F., inconvenience of copper wire ropes as lightning conductors, 9
 Michigan, University of, 27
 Mignon and Rouart, M.M., extraction of juice of sugar-cane by new apparatus, 152
 "Migration" and syphonment of gases, 184
 Milan-Nevoile, M., new butylic glycol, 63
 Milk trade, salicylic acid in, 142
 Millet, A., and Curie, J., compound of chloral and acetic chloride, 206
 Milne, J.M., presence of arsenic in vapours of bone manure, 132
 "Miners' Curfew and other Matters, Social and Political" (review), 6
 Mines, coal, fire damp in, 110
 measuring air in, 25, 36
 Mineral analyses, 141
 and organic phosphates in manure, 154
 new Cornish, 147
 nickel, from New Caledonia, 193
 phosphates and superphosphate of lime, 48, 55
 Minerals, American vanadium, 78
 examination of Chilean, 134
 Mineralogical notices, 71
 Miquel, P., stains produced by sulphocyanic acid, 250
 Mitchell, H. W., note on litmus, 140
 Molybdenum-pentachloride, use of, for the production of organic chlorides, 271
 Moriggia, A., natural poisonous nature of the human corpse, 144
 Morton, H., thallene, 188
 Moscow, chemical laboratory of University of, 163
 Mouchot, A., industrial application of the sun's rays, 183
 Moutchal, M., De Ruoz, H., and De Fontenay, M., applications of phosphide of copper and phosphor-bronze, 217
 Muir, M. M. P., bismuth compounds, 203
 action of water and saline solutions upon lead, 223, 234
 Müller, H., "Vegetable Fibre and its Preparation for Industrial Uses" (review), 181
 Müntz, A., influence of certain salts of lime on saccharimetry, 9
 Muso, G., and Manetti, L., salicylic acid in the milk trade, 142
 Muter, J., Prof. Dittmar and the "Analyst," 162
 "Mysteries of Nature and Discoveries of Science" (review), 247
 Myrny mines, oxide of iron enclosed in calcite and quartz at, 10

NAPHTHALIN compounds, constitution of some, 270
 Naphthalin-dinitro (α and β) derivatives from, 270
 Naphthylamin, aniline, phenol, and anthraquinone, the electrolysis of the derivatives of, 118
 Naquet, A., "Legal Chemistry, Detection of Poisons, Examination of Stains" (review), 18
 "Nature, Constants of" (review), 142
 "Nature, Mysteries of, and Discoveries of Science" (review), 247
 Naudin, L., and De Montholon, F., decomposition of cyanide of potassium and zinc, and formate of potassa in carbonic acid, air, and hydrogen, 92
 insoluble carbonates by sulphuretted hydrogen, 51
 Neville, R. H. C., compound of chromium arsenic, 220
 reaction of chromic acid with hydric peroxide, 19
 Nietski, R., aniline-black, 174
 preparation of thallium, 250
 Nickel, a meteoric iron rich in, 238
 and cobalt, new method of separating, 255
 silver alloy, 150
 metallic, extracted from the ores of New Caledonia, 50, 193
 ores in Spain, 72
 Nicol, N. C., anthracen in coal-tar, 94
 Nilson, L. F., platino nitrates and diplatino nitrates, 270
 Nitralizarin, 51
 Nitrates and infusoria, 33
 determination of, 41
 in water of the Thames, 82
 Nitro-alizarin, 10, 40
 Nitrogen, free, absorption of, by organic matters at ordinary temperatures, 9
 by the proximate principles of vegetables under the influence of atmospheric electricity, 205
 free determination in organic substances, 205
 Nitrous acid upon acetanilide, action of, 163
 Nolting, E., constitution of the derivatives of benzene, 142
 Norton, T. H., and Michael, A., preparation and properties of tri-iodo-resorcin, 270

OATMEAL, barley in, 194
 Odling, W., "Practical Chemistry for the Use of Medical Students" (review), 89
 Oils, essential, limited oxidation of, 127, 135
 fatty, action of upon metallic copper, 176, 200, 213
 Olivente, pharmacosiderite, and scorodite, occurrence of in greenstone at Terras Mine, 10
 O'Neill, C., "Textile Colourist" (review), 89
 Orchil, extract and paste, manufacture of, 72
 "Ores, Treatment of" (review), 50
 Organic bodies, metallisation of to render them fit to receive galvanic deposits, 9
 colouring matters, reagents on, 144
 ferments, origin of, 9
 matters at ordinary temperatures, absorption of free nitrogen by, 9
 combustion of under the double influence of heat and oxygen
 substances, action of certain filters on, 4, 11, 24
 determination of free nitrogen in, 205

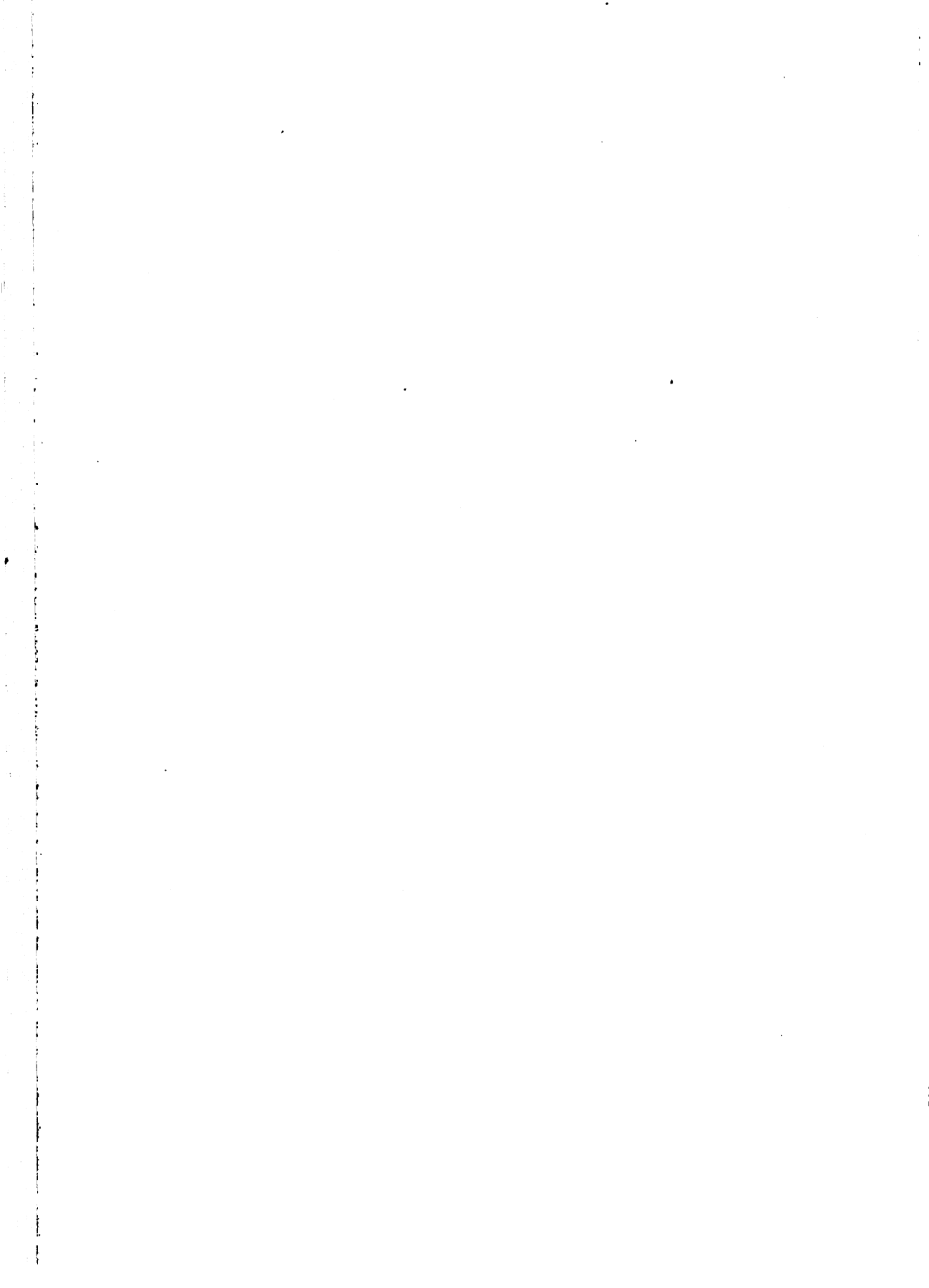
- Organisation among chemists, 62, 227, 238
- Organisms, animal, action of the turpentine and homologues of phenol, 270
- Ostwald, W., action of mass of water, 184
- Owens College, new scholarship in chemistry, 196
- Oxford, University of, 185
- Oxide, manganic, determination of, 19
- Oxides, manganese, analyses of, 39
- Oxygen and heat, combustion of organic matters under the influence of, 9
- Oxymercaptans, 218
- Oxythymo-quinon, 271
- Ozone, formation of by the contact of plants with peroxide of hydrogen, 209
- thermic, formation of, 3, 93
- PALLADIUM**, action of in an alcohol flame, 269
- electro-chemical deposits of, 227
- new properties of, 205
- Para-tolyl-phenyl ketone, derivatives of, 270
- Para-xylene acid, 270
- Paralidol, 82
- Pasteur, L., alteration of urine, 110
- and J. Joubert, fermentation of urine, 50
- origin of organic ferments, 9
- Paterno, E., and G. Brioso, on hesperidin, 72
- Paterson, G., analysis of iron deposit, 198
- Pattinson and Stead, barley in oatmeal, 194
- Pawloff, D., ethyl-isopropyl-ketone, 284
- Peat and coal, quantitative analysis of, 233
- Pecile, D., presence of guanin in the urine of swine, 206
- Pellet, H., determination of sulphuric acid and soluble sulphates by means of standard solutions, 9
- and P. Champion, determination of free nitrogen in organic substances, 205
- equivalent substitution in animals and plants, 134
- Peliger, E., action of boric acid and alkaline borates upon plants, 205
- Pendulum, compensating, new form of, 65
- Pepper and its adulterations, 154
- Pepsin, solution of damaged albumen in, 184
- Perkin, W. H., Address to Chemical Section of British Association, 104
- new derivatives of anthracene, 145
- Petit and Dulong, law of, 9, 21
- Pettengill, J., organisation among chemists, 62
- Pharmaceutical Conference, 84
- Pharmacosiderite, scorodite, and olivine in greenstone, at Terras Mine, 10
- Phenol, action of homologues on animal organisms, 270
- aniline, naphthylamin, and anthraquinon, the electrolysis of the derivatives of, 118
- behaviour of with cinchonic alkaloids, 153
- Phenols, phthalic acid with the, 206
- Phenyl-ketone, para-tolyl derivatives of, 270
- Phenyl-sulphate hydrogen and its homologues, synthesis of, 269
- Phenylene diamine, 256
- Philpison, W. T., elementary physics and geology, 154
- Phillips, S. E., study of chlorine substitution, 11
- "Philosophy in Earnest, Science in Sport" (review), 259
- Phipson, T. L., analyses of manganese oxides, 39
- calculator in horses, 151
- determination of manganic oxide, 19
- Infusoria and nitrates, 33
- "Letters on Mysteries of Nature and Discoveries of Science" (review), 247
- metallic dust in the atmosphere, 93
- on tripolite of Barbadoes, 108
- Phoenix Mine, new mineral from, 10
- Phosphine, 67
- action of on mercuric cyanide, 167
- reducing action of, 14
- Phosphates, mineral, and superphosphate of lime, 48, 55
- organic and mineral in manure, 154
- Phosphites, composition of, 272
- Phospho- and arseno-cyanogen, 203
- Phosphor bronze and phosphide of copper, applications of, 217
- Phosphorous pentasulphide, 153
- Phthalic acid with the phenols, 206
- benzyl-iso acid, 270
- Phthaleins of tertiary aromatic bases, 370
- Physical and chemical properties of ruthenium, 265
- Physico-chemical forces on phenomena of fermentation, 70
- Physics and geology, 154
- Pictet, R., freezing machines with sulphurous acid, 52
- Pigmentum nigrum, 203
- Pinchon, A., assay of commercial oils, 154
- Pine, extraction of vanillin from sap of, 144
- Pink liquors of chlorate of potash manufacture, 183
- Pisani, F., mineralogical notices, 71
- sulpho-antimonuret of lead found at Arnsberg, 206
- Planté, G., bead lightning, 134
- globular thunderbolts, 92
- Plants and animals, equivalent substitution of mineral matters in, 134
- formation of ozone by the contact of with peroxide of hydrogen, 4
- Plaster casts, prize for hardening, 39
- Plastic sulphur, 68
- Platinum combustion tubes, 67, 81
- Plato-nitrates and diplato-nitrates, 270
- "Platter and Cup" (review), 168
- Pneumatic malting-process of M. Gaillard, 72
- Poisoning, lead, 196
- "Poisons, Detection of, and Examination of Stains" (review), 18
- Polarimeter or saccharimeter, 284
- "Polytechnic School of Aachen, Programme for 1876-77" (review), 236
- Polytechnic School of Delft, 153
- Portes, L., asparagin in sweet almonds, 238
- and Ruysen, M., volumetric determination of formic acid, 32
- "Portrait Photography" (review), 223
- Potash, chloride of, apparatus for making, 139, 151
- pink liquors in manufacture of, 183
- theory of scurvy, 268
- Potassa, decomposition of formate of in carbonic acid, air, and pure hydrogen, 92
- process for the qualitative detection and determination of, 85, 216
- qualitative detection of, 122, 216
- Potatoes, effect of temperature on the growth of, 135
- Potassium and sodium iodides of bromide of potassium, preparing, 154
- cyanide of, action of upon halogenated compounds, 218
- decomposition of in carbonic acid, air, and pure hydrogen, 92
- estimation of as acid tartrate, 231, 242, 249
- fluoride of, 164, 185
- new reagent for, 216
- oxides of, 203
- tri-iodide, 222
- Potter, E. C., organic and mineral phosphates in manure, 154
- Pouchet, G., determination of tannin, 250
- Prinvaunt, M., Persian red, 10
- Proctor, B. S., effect of flexibility on the working of chemical balances, 14
- Prunier, L., researches on quercetin, 238
- Pseudo-sulpho-cyanogen, 80
- Public Analysts, salaries of, 20
- Society of, 218, 226, 249
- Puiseux, Jamin, and E. Becquerel, M.M., report of memoirs by Allard relating to the transparency of flames and atmospheres and the visibility of lighthouses with flashing lights, 9
- Pumps, Inns of Court, 19
- Purpurin, 10
- Puchot, E., iodine as a reagent for starch, 72
- Pyrites, gold in, determination of, 94, 132, 152, 172
- sulphur from, 218
- Pyrology, 177
- Pyrophyllite at Brookwood, and new mineral localities in Devon and Cornwall, 10
- Pyrotartaric acid, normal derivatives of, 32
- Pyrotechny, coloured fires used in, 139
- "QUALITATIVE Analysis, Appendix Tables to W. Dittmar's"** (review), 68
- Quantitative analysis of coal and peat, 233
- Quartz and calcite, oxide of iron enclosed in, at Mwyndy Mines, 10
- Quercetin, 238
- Quercetin and quercitrin, 184
- Quinon-oxythymo, 271
- RADAU, R., review of physics,** 51
- Radiation, repulsion resulting from, 23, 165, 175, 187, 209, 219, 229, 241, 253, 263
- Radiometer of Mr. Crookes, 8, 9, 21, 31, 32, 40, 51, 63, 83, 143, 261
- experimental contributions to theory of, 269, 275
- Radiometers, influence of sonorous vibrations on, 133
- intensity, 110
- Rays, spectral, theory of, 195
- sun's, industrial application of, 185
- Reboul, M., derivatives of normal pyro-tartaric acid, 32
- Red, Persian, 10
- Redmond, D.D., prize for hardening plaster casts, 39
- Reds from artificial alizarin and extract of madder, distinctive reaction between, 184
- Reductive sugar, transformation of saccharose into during refining, 71
- Redwood, T., Society of Public Analysts, 249
- Reid, W. C., mineral phosphates and superphosphate of lime, 48, 55
- Repulsion resulting from radiation, 23, 165, 175, 187, 209, 219, 229, 241, 253, 263
- Residual gas, influence of on the movement of the radiometer, 23
- Rhamnus frangula, emodin from the bark of, 271
- "Rhenish-Westphalian Royal Polytechnic School Programme for 1876-77" (review), 236
- Rhodein, a new reaction of aniline, 72
- from an analytical point of view, 133
- Rich, S. W., "Analysts' Annual Note-Book" (review), 38
- Richards, R. H., improved form of aspirator, 141
- Riche, A., and C. Bardy, commercial analysis of raw sugars, 40
- Richter, O., chemical constitution of the alcohols, 120, 129
- Ritter, E., and V. Feliz, researches on the action of aniline introduced into the blood and stomach, 32
- Römer, H., and E. Schunck, anthraflavic and iso-anthraflavic acid, 173
- anthrapurpurin and flavopurpurin, 131
- Roscoe, 46
- Rosenstiehl, A., anthraflavon, and an accessory product of the manufacture of artificial alizarin, 21
- nitralizarin, 10, 40, 51
- Rosetti, F., the radiometer, 143
- Ross, W. A., blowpipe analysis of Henwoodite, 156
- D-lines spectra flame examined by blowpipe, 212, 237
- nickel and silver alloy, 150
- pyrology, 177
- thermochromatism, or heat colouration, 108
- Rotatory power of cane-sugar, 110
- Rouart and Mignon, M.M., extraction of juice of sugar-cane by new apparatus, 152
- Routledge, R., "Science in Sport made Philosophy in Earnest" (review), 259
- Rowan, F. J., analysis of water of River Hooghly, 84
- "Royal Rhenish-Westphalian Polytechnic School of Aachen Programme for 1876-77" (review), 236
- Royal Society, 239
- Rugheimer, L., and W. Staedel, action of ammonia upon chlor-acetyl-benzol, 270
- Ruthenium, physical and chemical properties of, 265
- Ruysen, M., volumetric determination of formic acid, 32
- SACCHARIMETER or polarimeter,** 284
- Saccharimeter, influence of certain salts of lime on, 9
- Saccharine matter contained in the petals of flowers, 272
- Saccharose, transformation of into reductive sugar during refining, 71
- Salet, G., experiments with the radiometer, 32, 83
- theory of spectral rays, 195
- Salicylic acid in the milk trade, 142
- Saline solutions and water, action of upon lead, 223, 234
- Salt, preservation of iron from action of, 174
- soap directly from, 143
- Salts formed by peroxide of manganese, 8
- metallic, high melting-points, with special reference to those of, 281
- sulpho-urea with, 217
- of bismuth, certain new, 119

- Salts of lime, influence on saccharimetry, 9
Sanitary effects of Eucalyptus globulus, 272
Sansoni, M., and G. Capellini, magistry of sulphur, 154
Schaer, E., decolouration of indigo by hydro-sulphurous acid and persulphide of hydrogen, 250
Schiff, B., compounds derived from ammon-aldehyd, 144
Scholarships, Science, 206
Schools of Chemistry, 111
Schunck, E., and H. Römer, anthraflavic and iso-anthraflavic acids, 173
anthrapurpurin and flavopurpurin, 131
Schwarz, H., determination of gold in pyrites, 94
of theine in tea, 94
kamite and kalutz in Galicia, 184
Science, British Association for the Advancement of, 22, 722
Scholarships, 206
"Science and Industry, Record of" (review), 69
"Science, Discoveries of and Mysteries of Nature" (review), 247
"Science in Sport made Philosophy in Earnest" (review), 259
"Science, Key to Modern" (review), 271
Scientific information for ladies, 262
"Scientifiques Causeries" (review), 69
Scorodite, pharmacosiderite, and olivenite, occurrence of in greenstone at Terra Mine, 10
Scurry, potash theory of, 268
Seaweed, alkali obtained from, 201
distillation of, 237
manufacture of soda from by endosmotic lixiviation, 31
Selenious acid, action of hydracids upon, 51, 72
Senior, A., new reagent for potassium, 216
Sewage Committee of the British Association, 136
treatment of, 284
Sheep husbandry in Georgia, 195
Silver and nickel alloy, 150
metallurgy of in a moist way, 41
Silver-oxide, bromine, and water, oxidation product of glycogen with, 153
Simon, C., relation of the two specific heats of a gas, 206
Skey, W., evolution of antimony from stibnite by nascent hydrogen, 147
suspension of clay in water, 142
Skraup, M., action of halogens upon ferricyanide of potassium, 217
Smith, A., new process for estimation of chicory in coffee, 283
A. P., improved form of aspirator, 103
J. L., aragonite observed on the surface of a meteorite, 32, 87
compounds of carbon found in meteorites, 32, 153
new form of compensating pendulum, 65
R. F., estimation of potassium by means of acid tartrate, 243
W., preparing condensed hydro-carbides, 174
Soap directly from salt, 143
Sobrero, M. A., manufacture of dynamite, 93
Soda, use of hydrosulphite of as a reagent in the analysis of colours fixed upon tissues, 154
manufacture of from seaweed by endosmotic lixiviation, 31
Sodium and potassium, preparing iodides of, and bromide of potassium, 154
action of on benzol, 24
Soil, electric transmission through the, 142
Solar rays, maximum of the possible repulsive power of the, 31
Soldiani, A., detection and determination of glucose, 154
Solid water, 161
Solutions, standard, determination of sulphuric acid and soluble sulphates by means of, 9
Sorby, H. C., and Hodgkinson, W. K., Pigmmentum nigrum, 203
Stadel, W., and Rugheimer, L., action of ammonia upon chlor-acetyl-benzol, 270
Standard solutions, determination of soluble sulphates and sulphuric acid by means of, 9
Stanford, E. C. C., distillation of seaweed, 237
"Stanley's Metre-Diagram" (review), 151
Stannic ethide to stannous ethide, oxidised product formed during the reduction of, 203
Steel, change in physical properties of by tempering, 81
Stevenson, T., sulphurous acid as a disinfectant, 261
Stibnite, evolution of antimony from by nascent hydrogen, 147
Stolba, F., crystalline fluosilicates of iron and cobalt, 184
St. Petersburg, correspondence from, 250
Stroumbo, D. S., new experiments with the radiometer, 267
"Sugar-cane, Disease of" (review), 272
Sugar-cane, juice of, extraction by new apparatus, 152
rotatory powers of, 110
Sugar, crystallisation of, 63
Sugars, commercial analysis of raw, 40
Sulhorst, G., precipitation of zinc by sulphuretted hydrogen in presence of bisulphate of potassium, 94
Sulphate, hydrogen-phenyl and its homologues, synthesis of, 269
Sulphates, method of titrating alkaline, 272
soluble, and sulphuric acid, determination of by means of standard solutions, 9
Sulphides, alkaline, use of in dressing hides, 52
Sulpho-antimonuret of lead found at Arnsberg, 206
Sulpho-carbonates, alkaline, 94
Sulphocyanic acid, stains produced by, 250
Sulpho-cyanogen, pseudo, 80
Sulpho-para-bromo-benzoic acid, 271
Sulpho-urea with metallic salts, 217
Sulphuretted hydrogen, arrangements of apparatus for application of without smell, 280
decomposition of insoluble carbonates by, 51
precipitation of zinc by, in presence of bisulphate of potassium, 94
ureas, 92
Sulphur from pyrites, 218
magistry of, 154
Sulphurous acid as a disinfectant, 245, 261
Sulphur, plastic, 68
Sun's rays, industrial application of, 183
Superphosphates, &c., analyses of, 221
Spectra flame, D-lines of, examined by blowpipe, 212, 226, 237
Spectral rays, theory of, 195
Spectroscope, blowpipe with, for mineralogists, 91
determination of lithium by means of the, 94, 122
Spectrum below red ray, observations of by means of the effects of phosphorescence, 82
Spargatis, H., arsenic in ancient bronzes, 41
Swine, guanine in the urine of, 206
"Sweden, iron manufacture in" (review), 259
"Sydney City and Suburban Sewage and Health Board" (review), 170
Synthesis and analysis by the blowpipe, 177
of allantoin, 51
Syphonment and migration of gases, 184
TANNIN, determination of, 250
Tape worm, germs of in meat, 83
Tar, coal, anthracen in, 94
Taylor, M., cohesion and capillary action of films of water, 223
Tea, theine in, 94
"Technology, Massachusetts Institute of" (review), 141
Teller, A., and Guignet, E., chemical composition of the water of the Bay of Rio de Janeiro, 238
Tellurous acid, action of hydracids upon, 92, 133
Temperature, effect of on the growth of potatoes, 155
influence of upon magnetisation, 238
Terra Mine, occurrence of pharmacosiderite, scorodite, and olivenite in greenstone at, 10
Terrell, A., law of Dulong and Petit, 9, 21
Tertiary aromatic bases, phthalicins of, 270
Tetramethyl-ammonium, ferrocyanide of, 217
"Textile Colourist" (review), 89
Thallene, 188
Thallium, preparation of, 250
Thames water, nitrates in, 82
Theine in tea, 94
Thenard, M., observations on glycemia, 109
Thermo-chromatism, or heat colouration, 108, 132
Thompson, L., erythron, and some of its compounds, 134
"Miners' Curfew, and other Matters, Social and Political" (review), 6
presence of nitrates in the water of the Thames, 82
"Purification of Water and Other Things" (review), 19
Thomson, W., action of fatty oils upon metallic copper, 176, 200, 213
Thörner, W., derivatives of paratolyl-phenyl-ketone, 270
Thorpe, T. E., phosphorus pentafluoride, 153
Thymoquinone, 281
Tidy, C. M., composition and quality of the Metroplitan water, 216
Titrating alkaline sulphates, 272
astringent substances, new process for, 230
"Tokio, University of, Calendar for 1875" (review), 70
Tolyl-butylene, synthesis of, 271
Tiebout, A., effect of lightning during the storm of August 18, 134
Tréve and Durassier, MM., distribution of magnetism on surface of magnets, 217
dynamo-magnetic phenomenon, 227
etching action produced upon different metals by the acids, 206
Tribe, A., the Chemical Society, 7
Trichloral-cyanide, 284
Tri-iodide, potassium, 222
Tri-iodo-resorcin, preparation and properties of, 270
Tripolite, 133
of Barbados, 108
"Typhoid Fever and Allied Diseases, how to Avoid" (review), 181
Turkey-red, chemical and historical survey of, 195
Turner, M., estimation of urea, 282
Turpentine and homologues of phenol, action of upon animal organisms, 270
Tytko, P. G. W., new nickel mineral from New Caledonia, 103
Troschke, H., and G. Krämer, methyl-alcohol and dimethyl-acetal: aldehyds and ketones present in wood-spirit, 271
ULTRAMARINE, 163, 196
University laboratory of Graz, 153
of London, 10, 52, 73, 94, 206
Michigan, 27
Moscow, 163
Oxford, 185
"University of Tokio, Calendar for 1875" (review), 70
Urban, J., dissociation of bicarbonate of soda at 100°, 154
Urea, estimation of, 282
Ureas, sulphuretted, 92
Urine, alteration of, 110
fermentation of, 50, 250
of swine, guanine in the, 206
VALENTIN, W., thermo-chromatism, 132
Vanadium compounds, notes on, 2
in manufacture of aniline-black, 92
m ca, 46
minerals, American, 78
Vanillin from sap of pine, 144
"Vegetable Fibre, and its Preparation for Industrial Uses" (review), 181
Velden, R. V. D., and E. Baumann, action of the turpen-tines upon animal organisms, 270
"Ventilation of Hall of Representatives and South Wing of Capitol of the United States" (review), 235
Vermann, F., anthracene production, 210, 236
testing, 177, 191, 201
Villier, A., margaric chloride and its derivatives, 238
Virginia, University of, practical chemistry in the, 147, 168, 179, 190
Vitricous and crystalline origin of eruptive rocks, 206
Vivian, W., oxide of iron enclosed in calcite and quartz in the Mwyndy Mines, 10
WAGNER, J., distinctive reaction between reds from artificial alizarin and extract of madder, 184
solution of damaged albumen in pepsin, 184
Waldenmann, M. E., and C. Lieberman, emodin from the bark of the Rhamnus frangula, 271
benzhydroamic-ethyl ester, 41
Wallace, W., tripolite, 133
Walsh and Jones's decomposing-furnace, discussion on, 27
Wanklyn, J. A., action of certain kinds of filters on organic substances, 4, 11, 24
and E. T. Chapman, "Water Analysis" (review), 204
Prof. Dittmar and the "Analyst," 151, 183
Society of Public Analysts, 226
The Chemical Society, 7
Wartha, V., litmus, 184
Water, "action of mass" of, 1

- "Water Analysis" (review), 204
 Water analysis of Weissenburg, 73
 and saline solutions, action of upon lead, 223, 234
 chemical decomposition as illustrated by, 43
 colour in, estimation of, 77
 Metropolitan, composition and quality of the, 216
 on glass, action of, 271
 silver oxide and bromine, oxidation-product of glycogen with, 153
 solid, 161
 suspension of clay in, 142
 "Water, Purification of" (review), 19
 Waters, carbonic acid contained in, 110
 Watering roads, chloride of calcium for, 110
- Wehrlin, E., and P. Clermont, two new sulphuretted ureas, 92
 Weissenburg, water, analysis of, 73
 Weldon, W., process for manufacture of chlorine, 70
 Willgerodt, H., action of α -dinitrochloro-benzol upon acetamide and carbimide, 270
 Winckler, M., fuming sulphuric acid, 154
 "Wine and its Counterfeits" (review), 90
 Wine, magenta in, 227
 Wines, adulteration in, 164
 artificially coloured, detection of, 152
 arsenic, 71
 magenta in, 51, 272
 determination of the nature of colouring matters in, 238
- Wisdom, Look of the Balance of, 59
 Witt, O., phenylen-diamin, 256
 Witz, G., use of vanadium in the manufacture of aniline-black, 92
 Wöhler, F., action of palladium in an alcohol flame, 269
 Wood-spirit, aldehyds and ketones present in, 271
 Woodcock, R. C., analysis of superphosphates, &c., 221
 Wood, oil of, 85
 Wright, C. R. A., alkaloids of the aconites, 222
 Wurtz, A., composition of certain phosphites, 272
 paldol, an isomeric modification of aldol, 83
- XYLENIC, para-, acid, 270
- ZENONI, E., and T. Brugnatelli, alkaloid found in damaged Indian corn and mouldy maize bread, 144
 Zinc, cyanide of, decomposition of in carbonic acid, air, and pure hydrogen, 92
 dust, action of on the chlorides of sulpho-para-bromobenzoic acid, 271
 precipitation of by sulphuretted hydrogen in presence of bisulphate of potassium, 94
 Zincke, T., action of dilute sulphuric acid upon hydrobenzoin and iso-hydrobenzoin, 270
 and A. Blatzbecker, benzylisophthalic acid, 270
 L. Klippert, para-xyleneic acid, 270
 Zulkowski, K., apparatus for determination of hydrogen, 163

END OF VOLUME XXXIV.

E11
J1



AUG 12 1953

11 AUG 53

AUG 12 1973

11 AUG 1973

